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APPLICATION OF A TAXONOMICAL STRUCTURE FOR CLASSIFYING GOODS PROCURED BY THE FEDERAL GOVERNMENT

by

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Application of a Taxonomical Structure for Classifying Goods Procured by the Federal Government

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ABSTRACT

The concept of contracting as a science has been explored in depth in procurement research over the past several years. One of the most intriguing research efforts involved the development of a model for the classification of goods. This thesis describes the application and validation of the previously developed scheme for classifying items procured by the Federal Government. Three distinct homogeneous groups of goods (food service equipment, ship and marine equipment, and items unique to the P-3 ORION aircraft) were identified and classified using data collected from actual buyers of these goods. The primary objective of the research effort was to actually classify goods by using taxonomic methods, and in doing so, to validate the scheme for the classification of Government goods. Secondary objectives were to identify any improvements to be made to the scheme, and to propose potential applications for the model. The researcher was able to successfully apply the model to a diverse set of goods using the taxonomic methods outlined in the scheme, and provided some suggestions for improvement.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

The field of Government procurement is evolving as never before. Sweeping changes in personnel management, workforce professionalism, complexity of the material bought and onerous legislative oversight make this a dynamic, and sometimes difficult discipline. Depending on your perspective, Government contracting can be seen as a clerical field, a science or even as an art.

The concept of contracting as a science has intrigued procurement researchers in recent years. A major requirement of a science discipline is a description and classification of the subject matter (Park, 1986, p.90). Within the area of Government procurement, classification studies have been undertaken in contracting literature (Sweeney, 1989 and Smith, 1991), and contracting officer tasks (Fowler, 1987 and Page, 1989).

One of the most interesting classification studies was conducted by Brian Wenger in 1990 (Wenger, 1990). In it, he established a scheme for the classification of goods procured by the Federal Government based on the inherent characteristics of the goods themselves. This classification

of goods has its roots in the classification of products in marketing, and applies the taxonomic techniques commonly used in the sciences such as biology and zoology.

In viewing the universe of items procured by the Federal Government, there is a tendency to lump them into one amorphous mass without considering the inherent characteristics of each particular good. This view has implications in procurement legislation, where statutory and regulatory procedures rarely take into consideration the unique attributes of individual products. Given the complexities of Government procurement, there is a need for a classification scheme to provide strategic insight to procurement professionals.

There are currently two classification programs used to categorize Government goods, the Federal Supply Classification (FSC) and the Standard Item Classification (SIC). The FSC categorizes goods by their commodity group, while the SIC utilizes the business establishment within the structure of the U.S. economy as the distinguishing feature utilized for classification. However, neither the FSC nor the SIC provide the strategic insight desired about the intrinsic traits of the item, which are independent of both the commodity and the business unit which produced the good.

Brian Wenger in 1990, established a conceptual scheme for the classification of goods along a spectrum from simple to complex. The goal here was to develop a systematic approach to the categorization of the items based on established taxonomic methods, but simple enough to ensure that data collection and analysis could be achieved relatively easily. In Wenger's project, characteristics which reflect the vital attributes of a good were defined, and a limited number of goods were classified.

The researcher, in the study documented by the thesis presented here, proposed to confirm the results of Wenger's work by applying the classification scheme to three sets of goods routinely procured by the Federal Government. These items were categorized by applying the taxonomic structures put forth in the previous work. Classification of the goods was actually accomplished by the buyers at Navy Field Contracting and Defense Logistic Agency (DLA) activities that are tasked with the procurement of the goods selected.

The classification of these goods helped to prove the viability of the Government goods classification scheme, identified areas susceptible to improvement, and further validated the selection of the characteristics which best differentiate individual goods.

There are a number of potential benefits from a program designed to classify goods. Identification of best procurement strategy, workload management and aid in determining contract type by highlighting potential risk classes are examples. This study also discussed potential applications of such a program.

B. OBJECTIVES

The primary objective of this study is to determine the viability of the Government goods classification scheme developed by Wenger. Specific objectives of this study include:

1. Identify taxonomic methods used in science (especially zoology and biology), marketing and in other areas of procurement research.

2. Confirm the validity of the scheme for the classification of Government goods previously established by Wenger, by actually classifying items using data compiled from input from actual buyers of the items.

3. Critique the scheme, and validate the choice of characteristics used to classify goods.

4. Propose several areas where such a program might be applied.

C. RESEARCH QUESTIONS

The following research questions served as a guide and were addressed during the course of this study:

Primary Research Question:

Can the previously developed scheme for the classification of goods procured by the Federal Government be validated by applying it to a group of homogeneous items which are currently being purchased by buying activities within the Department of Defense?

Subsidiary Research Questions:

1. For the purpose of this procurement research effort, which groups of homogeneous goods should be chosen and within those homogeneous groups, what a priori attributes should the individual items possess, that will make them useful in confirming the viability of the classificatory scheme?

2. Were the characteristics chosen as essential to the proper classification of goods in the previous study, the correct attributes for this type of effort?

3. What improvements can be made to the classificatory scheme?

4. What are the potential areas of application for this scheme?

D. RESEARCH METHODOLOGY

The research was conducted by the following means:

- Comprehensive literature review
- Selection of buying activities, and site visits
- Selection of items for the classification effort, and preparation of the survey instrument
- Data collection
- Quantitative analysis of the data using cluster analysis.
- Application of the data to the classification scheme

The researcher first conducted an in-depth review of the applicable literature on classification, general taxonomy and the use of taxonomic methods in procurement research. The results of this effort are described in Chapter II.

The activities to provide the classification data were then selected, and a site visit conducted to explain the purpose of the research, and to aid in the selection of the items to classify. The next step involved the preparation of the survey instruments, and the process of data collection. These are described in Chapter III.

Upon receipt of the data, analysis was conducted using the cluster analysis routine contained in the SAS statistical program. The data were analyzed in separate groups, and were then analyzed in aggregate. These results are reported in Chapter IV.

Based on the results obtained from the cluster analysis, attributes were then removed to streamline the scheme. The results of this attribute removal validated the process used by Wenger to similarly simplify the model. The outcome of the analysis was then applied to the classificatory scheme. Comments on conduct of and improvements to the process were then made. These areas are contained in Chapter V.

E. SCOPE, LIMITATIONS AND ASSUMPTIONS

The scope of the study is limited to validating the previously developed model, making some suggestions for improvement to this model and identifying potential applications. Additionally, the model was expanded to include all twelve characteristics identified by Wenger, before streamlining the model. The information gained by analyzing all the characteristics served as the basis for validating the removal of characteristics.

The following assumptions apply:

1. The previously developed scheme for the classification of goods procured by the Federal Government can be used to classify a set of homogeneous goods.

2. The twelve characteristics identified in the scheme are the best ones for classifying goods.

The following limitations apply:

1. Only a finite number of goods will be analyzed. While it would be desirable to classify all items procured by the Federal Government, the sheer enormity of such an undertaking are well beyond the capabilities of this study.

2. Services were not be considered. Only goods were classified as a part of this study.

F. COMPREHENSIVE LITERATURE REVIEW

The graduate thesis "A Taxonomical Structure for Classifying Goods Purchased by the Federal Government" (1990) by Lieutenant Brian Wenger served as the base document for the

study. It was source for the basic structure of the scheme, and provided the background methodology for the project.

The book Principles of Numerical Taxonomy by P. H. A. Sneath and R. R. Sokal provided substantial background, as did the journal article "Product Characteristics and Marketing Strategy" by Gordon Miracle. The latter was especially useful in describing the classification of goods for marketing applications.

Significant information pertaining to the analysis of the data was provided by H. Charles Romesburg's Cluster Analysis for Researchers and SAS Users Guide: Statistics, Version 5 Edition (1985). Both works provided the background and the mechanics to allow the researcher to complete the cluster analysis.

G. CHAPTER SUMMARY

This chapter outlined the purpose and structure of the research effort. Chapter II will provide an introduction to taxonomy and its applications, and will provide the background information for this project.

II. BACKGROUND

A. PURPOSE

The purpose of this chapter is to introduce the concept of classification, explore how classificatory schemes are utilized, and to develop an understanding of the use of taxonomic structures in both the sciences (physical and social) and in procurement research. The focus of this section will be:

1. Examine the science of taxonomy, including its philosophy and techniques. Emphasis will be on the use of taxonomic schemes in the physical sciences.

2. Outline the uses of taxonomy in research conducted in procurement.

3. Review the research conducted in the taxonomy of goods procured by the Federal Government, and highlight potential problems.

B. INTRODUCTION

Several recent procurement research efforts have focused on the use of classification schemes to logically organize the processes and tools used in contracting. This is a natural continuation of the concept of contracting as a science proposed by Steven Park in 1986 (Park, 1986, p. 12).

This concept of systematic classification has been extended to products purchased by the Government, with research also being conducted into the classifying of services procured by the Government.

The field of contracting has become significantly more complex in recent years. The number of rules, regulations and directives used in procurement, as well as the technical intricacies of the items being purchased have expanded dramatically. Similarly, the enormous costs of contracting mistakes both in real dollar terms and in a public relations sense make it imperative that there is an understanding by buyers of what they are purchasing. In order to ensure that the immense amount of information required of contracting and procurement professionals is logically organized and disseminated, a systematic method of classification is required.

This concept of contracting as a science is one that has gained favor in recent years, since the hierarchal nature of science has a useful application in the study of procurement activities. If contracting is indeed a science as has been postulated, then it must meet the following substantive characteristics defined by Park: (Park, 1986, p. 41)

1. A distinctive subject matter.

2. The description and classification of the subject matter.

3. The presumption of underlying uniformities and regularities concerning the subject matter.

4. The adoption of the method of science for studying the subject matter.

It is the second scientific characteristic that has been explored significantly in recent years with respect to procurement. Taxonomies of procurement literature, contracting officer tasking and procurement tasks have all been developed. Similarly, a model for the classification of goods has been developed and empirical research into the validity of this model is the main thrust of this thesis.

In light of the research cited above, classification of the different aspects of contracting is an important activity. This taxonomic procedure has its roots in the hard sciences, and it is important that this process be understood before applying it to procurement. This chapter will discuss how and why taxonomic structures are used in science and other disciplines, how this classification process has been applied to procurement, and how the goods procured by the Government can be classified using the model developed recently by Brian Wenger.

C. DEFINITION OF TERMS

Before proceeding any further into a discussion of taxonomy and classification, it would be useful to define some of the critical vocabulary used. This is particularly true of the word taxonomy itself, which is often confused with taxidermy. The following is a hierarchal listing of basic taxonomic terms:

- Taxonomy- The theoretical study of systemic classifications including their bases, principles, procedures and rules. The science of how to classify and identify.

- Classificatory System- The end result of the process of classification, generally a set of categories or taxa.

- Classification- The ordering or arrangement of entities into groups or sets on the basis of their relationships, based on observable or inferred properties.

- Identification- The allocation or assignment of additional, unidentified objects to the correct class, once such classes have been established by prior identification.

- Taxon- A group or category in a classificatory system resulting from some explicit methodology. The plural is taxa.

- Units- Objects and entities that are identified as belonging to one or more taxa constituting a classificatory system.Identification is based on an explicit methodology focusing on the similarities/dissimilarities of the units. (Fleishman and Quaintance, 1984, p. 22)

D. PURPOSE OF CLASSIFICATION

Classification is a normal part of life. Infants arrange things into convenient groupings: hot/cold, safe/dangerous, big/small, just as primitive man did. However, in attempting to understand the complexities of the world in which we live, there is a need to categorize things beyond the simple steps illustrated above. In describing the reasons for classifying, the noted taxonomist, Robert Sokal said:

> All classifications aim to achieve economy of memory. The world is full of single cases: single individuals of animal or plant species, single case histories of disease, single books, rocks or industrial concerns. By grouping numerous individual objects into a taxon, the description of the taxon subsumes the individual descriptions of the objects contained within it....
>
> The paramount purpose of a classification is to describe the structure and constituent objects to each other and to similar objects, and to simplify these relationships in such a way that general statements can be made about classes of objects. (Sokal, 1974, p. 1116)

In its most basic form, classification is the science dealing with the similarities (and by extension, differences) between individual entities. Chrisman, Hofer and Boulton stated the objectives of a taxonomic structure as: (a) differentiation, (b) generalization, (c) identification and (d) information retrieval. (Chrisman, Hofer and Boulton, 1988, p. 415). Thus, by synthesis, a

classification system allows us to achieve four goals:

1. Economy of memory.
2. Ease of manipulation
3. Ease of information retrieval
4. Description of the structure and relationship of constituent objects. (Sokal, 1974, p. 1116)

It should be noted that at no time should classification be viewed as a means unto itself. Rather, it should serve as a facilitator in the study of other areas.

1. Taxonomy in the Sciences

The ancient Greeks, notably Plato and his student Aristotle are credited with the development of classification as a science in itself. They separated classificatory systems into two types: (1) arrangements based on tangible or visible attributes, and (2) classifications based on concepts or ideas. (Fleishman and Quaintance, 1984, p. 19)

The physical sciences, especially biology and its subsets of zoology, botany, ichthyology, etc., have been involved in the use of taxonomy far longer than other disciplines, and have developed numerical as well as cladistic approaches to classification. In fact in thinking of taxonomy, it is biology with its descriptions of Kingdoms, Phyla, Families, Genuses, etc., that readily comes

to mind. Therefore, it would be particularly wise to review biological taxonomic practices for their insight into the general issues and complexities of taxonomy.

a. Taxonomy in Biology

In reviewing the role of taxonomy in the biological sciences, Fleishman and Quaintance delineated some priorities and an order that must be established in beginning a classificatory effort. (1) The taxonomist must state the purpose of the classification. (The why of the effort.) (2) The descriptive base to be used to differentiate the objects into their respective categories must be outlined. (The what of the effort.) (3) What methodology is the researcher using to validate his classification scheme. (The how of the effort.)

Biologists seek to put some order and logic into the vast array of creatures that they observe. Generally, biologists seek to: (1) relate living organisms to some externality (ecological classification), (2) show the usefulness of organisms (teleological classification), or (3) reveal the inter-relationships among the organisms themselves (theoretical classification). An examination of biological classification shows that there has been no explicit criteria developed for teleological or ecological

classifications, and for the most part these have been ad hoc efforts. (Fleishman and Quaintance, 1984, pp. 25-26)

Theoretical classification has been widely used in biology, while ecological and teleological classification have received little or no scientific interest. Within the theoretical school there are three major groupings of taxonomic thought: Linnaean, Darwinian and Numerical.

Linnaean taxonomy is based on the Aristotelian logic of basing classification on the "essence" of the item.

> Linnaean taxonomy reduces the "how" of classification to an attempt to define the "essence" or "essential nature" of groups of organisms. Some unique set of characteristics is deemed necessary and sufficient (e.g., breasts characterize mammals) for classification. (Fleishman and Quaintance, 1984, p. 26)

This scheme has been criticized for its large amount of subjective judgment. The "essential nature" of the organism is based solely on the professional opinion of the classifier. Another criticism is that Linnaean groups tend to be monothetic, which means that all members possess a unique set of features. The danger here is that an odd individual with the one defining attribute, but no other commonalities will be mis-classified. Finally, Linnaean taxonomy: "can never serve as the basis for a scientific classification, mainly because of its lack of empirical verification". (Fleishman and Quaintance, 1984, p. 26).

The next type of taxonomic thought is Darwinian, which postulates that evolution is the only valid basis for classification. The small amount of data available to the Darwinian taxonomist is the principal criticism of this theory.

> A scientific classification should not be founded upon hypothesized relationships or speculations that merely reflect the subjective opinions of some taxonomist. If subjective opinions or theories solely deductive in nature are permitted as the bases for classification, there could well be as many classifications as there are theorists, with the resulting classifications being only as stable as the speculations on which they are founded. (Fleishman and Quaintance, 1984, p. 27)

The final school of biological taxonomic thought belongs to the numerical taxonomists. Numerical (phenetic) taxonomy proposes that:

> ...the relationships of contiguity and similarity should be sought by a quantitative analysis of the overall similarity of the organisms, based on the widest possible range of physical and functional characteristics of the organisms themselves. (Fleishman and Quaintance, 1984, p. 27)

The numerical taxonomist seeks to avoid the criticisms of the Darwinian and Linnaean schools by eliminating subjectivity through the use of empirical data. To avoid the subjectivity assumptions numerical taxonomists have established "repeatability" and "objectivity' as the main aims of their approach. To achieve these goals, the following axioms have been proffered:

1. The ideal taxonomy is (one) in which the taxa have the greatest content of information, (being) based on as many characteristics as possible.

2. A priori, every character is of equal weight in creating natural taxa.

3. Overall similarity (or affinity) between any two entities is a function of the many characters (on) which they are being compared.

4. Distinct taxa can be constructed because of diverse correlations in the groups under study.

5. Taxonomy...is, therefore, a strictly empirical science.

6. Affinity is estimated independently of phylogenetic considerations. (Fleishman and Quaintance, 1984, p. 28)

The philosophy of the numerical taxonomist is that a resulting classification can be neither right or wrong. Numerical taxonomy is not a theory, but merely a way of summarizing information in an intelligible form. (Dunn and Everitt, 1982, p. 6)

The wide array of characteristics considered by the numerical taxonomist created such a mass of information that phenetic taxonomy did not become feasible until the advent of the high speed computer, with its ability to track and compare vast amounts of data. Recent developments in computer technology, as well as the avoidance of the

criticisms found in the "traditional" schools, have pushed numerical taxonomy to the forefront of the field.

Central to the discussion of taxonomy in the biological field is that before attempting to classify, there must be an adequate classification system. Similarly, there must be a purpose and method to the classification system. These prerequisites help to preclude the wasting of efforts in attempting to classify using a system which is poorly conceived or incomplete. These concepts are common to all classification endeavors.

Taxonomic efforts, similar to those found in biology, have also taken place in the social sciences (taxonomies of organizations, for instance) and in psychology. Some work on the classification of goods in the field of marketing has taken place, but it remains mostly in the theoretical vice practical phase.

E. CLASSIFICATION SCHEMATA

As illustrated above, systems of classification are generally involved with the differentiation of individuals into groups with like characteristics. In the field of modern numerical taxonomy, there are generally two methods of developing classification schemes. The first scheme is called logical partitioning which involves the development

of the scheme before (e.g., a priori) any data are analyzed. The second scheme is referred to as grouping procedures and starts with the specification of the phenomena to be classified. However, the resulting scheme is based on the results of the data being scrutinized.

In establishing a successful classification system certain principles, criteria and conditions must be met:

1. The classification scheme should adequately specify the phenomenon to be classified.

2. The scheme should adequately delineate the characteristics used in classifying.

3. The scheme's categories should be mutually exclusive. (e.g., the item should fit only into one category of classification.)

4. The scheme's categories should be collectively exhaustive. (e.g., Every item classified is put into a category. A large number of items in a miscellaneous grouping indicates a flawed system.)

5. The classification scheme must be useful. (Hunt, 1983, p. 355)

Additionally, Wenger proposed that the system be internally homogeneous (e.g., The items within the categories should be separate and distinct from items in other categories.)
(Wenger, 1990, p. 15)

F. TAXONOMIC APPLICATIONS IN PROCUREMENT

As mentioned earlier in this chapter, there has been a fair amount of research done into the classification of different aspects of procurement as the notion of contracting as a science becomes more prevalent. Park in 1986 first proposed the concept of contracting as a science, along with the requirement for a classification scheme. (Park, 1986, p. 12)

Clark Fowler in 1987 explored the taxonomic structure of procurement tasks. (Fowler, 1987) Similarly, Asa Page in 1989 developed a taxonomy of the tasks performed by the contracting officer. (Page, 1987) Richard Sweeney in 1989 conducted classification analyses of the available contracting literature. (Sweeney, 1989)

1. The Need for a Classification Scheme

While the work mentioned above was significant, they provided little insight into the strategic approaches to buying Government goods. It appeared that significant benefit could be derived from clustering individual goods into groups based on considerations deemed important to the contracting process. (Lamm and Wenger, 1990, p. 1) A major problem is: "Often, critics of the acquisition process assume that the characteristics of purchasing ordinary consumer goods can be readily transferred to the acquisition

of unique systems." (Judson, 1986, pp. 14-15) Additionally, "Frequently when additional oversight is mandated, little thought is given to the differences in product complexity or procurement procedures involved." (Lamm and Wenger, 1990, p. 2)

2. General Benefits of a Strategic Classification

Given the need for a classification scheme as delineated above, the following benefits would be realized:

1. Better understanding of the relationships between goods.

2. Segregation of goods within commodity type.

3. Differences in complexity or procurement procedures would be recognized in formulating regulations and policy.

4. Accurate determination of acquisition strategies.

5. Application in the logical budgeting of operating funds to contracting activities based on inherent characteristics of the item, vice other less descriptive measures such as unit price.

Wenger in 1990 developed a model for the classification of goods procured by the Government. It is this taxonomic model that the researcher is attempting to empirically prove, and will be discussed in the next section in detail.

G. CLASSIFICATION OF GOODS

There is only a minimal amount of literature available dealing with the taxonomy of goods, and most work accomplished in this area has been conducted in the field of marketing. The current Government classification schemes as well as classification initiatives in business are reviewed in this section to provide a basis for the discussion of the Wenger taxonomical model for classifying Government procured commodities.

1. Government Classification Schemes

There are currently two schemes for classifying goods procured by the Government. They are the Federal Supply Classification (FSC) and the Standard Industrial Classification (SIC). An examination of these schemes would be illustrative:

a. Federal Supply Classification (FSC)

The FSC is a system of classification of supplies based on their commodity group. The description from the Cataloging Handbook states:

> The FSC is a commodity classification designed to serve the functions of supply and is sufficiently comprehensive in scope to permit the classification of all items of personal property. In order to accomplish this, groups and classes have been established for the universe of commodities, with emphasis on the items known to be in the supply systems of the Federal Government.

> The structure of the FSC, as presently established, consists of 78 groups, divided into 620 classes. The Federal Supply Group (FSG) identifies, by title, the commodity area covered by classes within the group. Each class covers a relatively homogeneous area of commodities, in respect to their physical or performance characteristics, or in the respect that the items included therein are such as are usually requisitioned or issued together, or constitute a related grouping for supply management purposes. (Federal Supply Classification Handbook H2-1, 1989, p ii)

b. Standard Industrial Classification (SIC)

This is a system of classification based on economic activity, and organized to reflect the structure of the U.S. economy. It does not follow any single principle, such as raw materials, product or market structure. The basic unit classified is the establishment, and each establishment is classified according to its primary activity. The purpose of this scheme is to provide a system of data collection, tabulation and presentation of statistical data relating to business establishments in the United States. (Federal Supply Classification Cataloging Handbook H2-1, 1989, p. 4) Both schemes, while useful in their own right, do not satisfy the need for a strategic classification of goods.

2. Marketing Classification Schemes

The need for a system of classification of goods has long been recognized in the field of marketing. There has been a recognition that: "An observable relationship exists

between the characteristics of a product and the approximate marketing mix for that product." (Miracle, 1965, p. 19) By extension it is possible to see a corollary in the procurement process, and the research done in classifying goods for marketing purposes are very applicable here.

Gordon Miracle proposed a system for the classification of goods based on their "product characteristics" as a basis for making this connection between product attributes and marketing strategy. Miracle set forth a number of characteristics that he felt would allow for logical grouping of the commodities. These characteristics are:

1. Unit value
2. Significance of each individual purchase to the consumer.
3. Time and effort spent purchasing by consumers
4. Rate of technological change (including fashion changes)
5. Technical complexity
6. Consumer need for service (before, during or after sale)
7. Frequency of purchase
8. Rapidity of consumption
9. Extent of usage (number and variety of consumers and variety of ways in which the product provides utility.)

(Miracle, 1965, p. 20)

FIGURE 2-1 Product Characteristics

Miracle then was able to place all products into five groups using a subjective ranking of the individual's attributes based on the classification characteristics

listed above. For instance, candy bars would be very low in unit value or rate of technological change, and very high in rapidity of consumption. Similarly, electric generators would be very high in the unit value category, and very low in frequency of purchase. Examples of the items from the five groups are:

Group I	Candy bars, soft drinks and razor blades
Group II	Small hardware items, proprietary pharmaceuticals and dry groceries
Group III	Radios, television sets, tires and athletic equipment
Group IV	Farm machinery, automobiles, quality household furniture
Group V	Steam turbines, electrical generators and machine tools

FIGURE 2-2 Product Classification Groups

Classification under this scheme allowed the businessman to develop strategic plans for policy and marketing mix. (Miracle, 1965, p. 24) Miracle acknowledged a shortcoming of this scheme by saying: "It is, of course, an artificiality to classify products by groups; and it would be more accurate to place products on a continuum, or within a spectrum ranging from one extreme to another."

Despite the acknowledged limitations of the Miracle classification scheme, it has proven useful in marketing. Similarly it has served as basis for the Wenger taxonomical model, "Because of the strategic implications of a good's characteristics and an orientation from the buyer's perspective." (Sokal, 1974, pp. 21-22)

H. WENGER TAXONOMICAL MODEL

The Wenger taxonomical model (hereafter referred to as the taxonomical model or simply "the model") drew very heavily on the work of Gordon Miracle described above. Using the characteristics proposed by Miracle along with several additional characteristics proposed by Robert Judson in his analysis of the acquisition environment (Judson, 1986, p. 14), a preliminary list of 22 characteristics of Government procured goods was obtained. They are shown in Figure 2-3.

These goods were then examined to determine those that would be best suited to use in a classification scheme. Members of an expert panel of National Contract Management Association (NCMA) Fellows were interviewed to narrow and refine the original list of 22 items. The revised list of 12 items is shown as Figure 2-4.

1. Unit Value.
2. Significance of each individual purchase to the Government.
3. Time and effort spent purchasing by the buyer.
4. Rate of technological change.
5. Technical complexity.
6. Need for service (before, during, or after sale)
7. Frequency of purchase
8. Rapidity of consumption
9. Extent of usage (number and variety of users and variety of ways in which the good provides utility).
10. Amount of price negotiation.
11. Alternative sources availability.
12. Degree of contractor financing available.
13. Amount of product homogeneity.
14. Factors considered by the buyer (price, quality, availability and technology).
15. What determines price.
16. Amount of choice available to the buyer.
17. Stability of requirements.
18. Amount of short-range versus long-range planning
19. Usage-planned and useful consumption, or acquired as "insurance" (i.e., major weapon systems).
20. Extent to which goods are customized.
21. Extent to which buyer exercises judgement in meeting needs of requiring activity.
22. What is nature of the demand for the good.

(Wenger, 1990, p. 27)

Figure 2-3 Preliminary Goods Characteristics

1. Change
2. Complexity
3. Customization
4. Maintainability
5. Homogeneity
6. Consumption
7. Unit Cost
8. Documentation
9. Item Attention
10. Sources
11. Criticality
12. Stability (Lamm and Wenger, 1990, p. 3)

Figure 2-4 Revised Goods Characteristics

The 12 revised characteristics were then fully defined and scaled to establish distinctions between characteristics. The twelve characteristics and scales are shown in Appendix A. The next phase in the model's development involved actually classifying a sample group of 21 different commodities based on the 12 characteristics mentioned in Figure 2-4 and Appendix A. The list of sample commodities appears as Figure 2-5.

A survey of 139 NCMA Fellows was conducted, and the resultant data were analyzed using cluster analysis methodology, which is currently the most popular method of numerical taxonomy. (Lamm and Wenger, 1990, p. 26)

1. General office microcomputers
2. Fork lift trucks
3. Guided missiles
4. Electronics countermeasure equipment
5. Paper towel dispenser
6. Pneumatic chisel
7. Floating drydock
8. 16mm film projector
9. Cold food counter
10. Submarine periscope
11. Filing cabinet
12. Sandpaper
13. Aircraft fire-control embedded computer
14. Bottled salad dressing
15. Nuclear Reactors
16. Semi-conductor assembly
17. Shipboard washing machine
18. Fluorescent light tubes
19. Pneumatic tires (non-aircraft)
20. Micrometer (general purpose)
21. Flat washers (Wenger, 1990, p. 44)

Figure 2-5 Commodities Sampled

The examination of the cluster analysis results revealed that six of the characteristics could be eliminated. Specifically:

> Along with an examination of the range of means for each of the 12 attributes, cluster analysis signalled the possible elimination of six attributes. While those attributes eliminated could describe three goods, their relative consistency across the various groups added little to the distinction between the goods. Because their consideration did not essentially add to the differentiation between clusters, retaining them merely caused a burden to the classification scoring process. (Lamm and Wenger, 1990, p. 6)

The six characteristics that remained are:

1. Complexity
2. Customization

3. Maintainability
4. Unit Cost
5. Documentation
6. Item Attention

Full definitions, along with the scaling criteria are included as Appendix A. (Wenger, 1990, p, 122-123)

A system of matrices was developed along with the criteria to allow for analysis of the classification data. Each grid allows for scoring within categories from simple to complex, based on an aggregate of the classifier's inputs. Additionally, symbols were used in the matrices, to further indicate the good's position along more of a continuum, rather than in discrete scoring categories.

As discussed before, the purpose of this thesis is an attempt to verify the model established by Brian Wenger. In attempting to authenticate the taxonomical model, the researcher will include the six attributes removed by Wenger in his study as part of the analysis.

I. SUMMARY

This chapter has examined the basics of the science of taxonomy, and has discussed some of its potential uses in procurement research. A primary objective of this chapter was to introduces the taxonomic model developed by Brian Wenger in 1990, which the researcher will attempt to validate in the course of this thesis. The next chapter

will establish the research methodology used to substantiate the use of taxonomic methods in the classification of goods.

III. RESEARCH METHODOLOGY

A. PURPOSE

The purpose of this chapter is to outline the research methods used in attempting to validate the taxonomical model for the classification of goods introduced in the previous chapter. A discussion of the methods used in the inquiry, the underlying investigative logic, as well as some of the data collection difficulties encountered will be discussed.

B. RESEARCH METHODS

The basic concept behind this investigative effort was to attempt to apply the model to a buying organization within the Department of Defense (DOD) as suggested by Wenger. The collection of raw data to be used in the classification effort was to be accomplished by querying buyers at the activities chosen via survey. These data would then be analyzed using the protocols for analysis established in the earlier thesis. The resulting information could then be used to prove or disprove the validity of the model. Additionally, it was the desire of the researcher to make improvements where possible, as well as to make substantive recommendations for application.

1. Selecting the Buying Organizations

The buying activities were chosen based on size in terms of personnel (buyers). Using a survey as the data collection vehicle required a reasonably large population of possible respondents in order to obtain sufficient measurements for analysis. Although it was unreasonable to expect that all the contracting officials queried would have the detailed knowledge that would come from actually buying the items on the survey, it was hoped that the buyers would have some general working knowledge of the types of items to be classified, which they could use in concert with their professional contracting skills to provide useful data.

In choosing the activities, the number of homogeneous groupings of material was also important, as that gave the researcher a reasonable base from which to select the items to be classified.

The activities chosen for the research effort were the Navy Aviation Supply Office in Philadelphia, Pennsylvania, and the Defense General Supply Center in Richmond, Virginia. These organizations were chosen because of their excellent fit into the selection criteria listed above (large population of buyers, large and diverse groups of goods). A brief description of each organization follows:

a. Navy Aviation Supply Office (ASO)

The Navy Aviation Supply Office (ASO) is the Inventory Control Point (ICP) for aviation assets in the U.S. Navy. It has primary roles as both a supply support ICP and as program support ICP. As stated in the ASO Annual Report:

> ASO's mission is to plan, develop, employ and control systems which provide worldwide support to Naval aviation. This includes proactive use of integrated logistics data to identify and establish the most effective support options. (ASO Annual Report, 1990, p.3)

In support of this mission, ASO performs inventory management, inventory forecasting, requisition processing, configuration management, provisioning, as well as procurement of a variety of aviation unique parts for immediate use, supply system stocks or initial outfitting. Within the Procurement Directorate (Code 02), there are approximately 250 contracting personnel (GS-1102, 1105, 1106 series) spread among three procurement divisions and the Procurement Support Division. Each Procurement division is set up for dedicated support for a limited range of aircraft Type/Model/Series (T/M/S). For example, Procurement Division 2 (Code 022) supports anti-submarine warfare (ASW), electronics and trainer aircraft, exclusively, and will make purchases in support of these aircraft types. The significance of this division of purchasing responsibility

will become apparent in the discussion of the selection of items to classify.

b. Defense General Supply Center (DGSC)

The Defense General Supply Center (DGSC) is responsible for the inventory management and procurement of a vast array of materials in support of all the Services within the Department of Defense. As a supply support ICP, DGSC has cognizance over such diverse items as welding equipment, lighting equipment, food service equipment, buoys and photographic supplies that are expected to have common uses by DOD components.

Within the Directorate of Contracting and Production at DGSC, there are over 300 full time civil service and military personnel. Of these, approximately 170 are employed in the two main contracts divisions. Procurement responsibilities are assigned to the branches within the divisions based on commodity as delineated by the Federal Supply Code (FSC), vice the end item application (i.e. specific Type/Model/Series of aircraft) as was the case with ASO.

2. Selecting the Items to be Classified

Once the buying activities to be surveyed were established, the next step was to select the items to be

classified. In choosing the items, the following heuristics were used:

1. The items would need to be fairly recognizable. Since the sole identifier for the respondent was nomenclature, the aim was to select items that would have name recognition for even the most casual observer.

2. The items chosen would be of an equipment nature vice a piece part nature. Again due to the use of nomenclature to identify the item to the buyers, it was felt that an item on the equipment level, would be less likely to generate confusion. For instance, a propeller for the P-3 Orion aircraft would be more recognizable than a capacitor, which would come in a wide variety of sizes, shapes and capacities.

3. The items to be surveyed would be a part of a homogeneous grouping, based on the organization of the activity selected.

4. The descriptions of the items to be classified were to be purposely generic to avoid creating an a priori bias in the way that the survey was presented.

In choosing the items to be classified, the organization (in terms of procurement workload management) of the buying activities was also considered. As mentioned previously, ASO allocated buying responsibilities based on the type of aircraft supported (i.e. end item application) by the respective procurement division. DGSC, on the other hand, allocated workload based on commodity, and did not consider the end application. Thus the idea of what constituted a homogeneous grouping was unique to each organization. These differences enabled the researcher to

establish the sample of items to be classified based on particular product relationships of each organization.

a. ASO Items

Items to be classified at ASO were to be from the P-3 Orion ASW patrol aircraft. The P-3 was chosen because of its relatively simple design (it is based on the Lockheed Electra passenger aircraft of the 1950's), its longevity (it has been active for three decades) and its variety of equipments (not only does it have sophisticated avionics, navigation equipment and weapon systems, but it also has a galley, sleeping provisions and a head). Choosing a single aircraft also offered the advantage of specificity in identifying to the respondents, the items to be classified.

In choosing the P-3, the potential respondents were narrowed to those contracting personnel in the anti-submarine warfare/electronics/trainer (A/E/T) Procurement Division (Code 022) at ASO. Additionally, in order to broaden the data base, personnel from the P-3 Orion weapon system management branch (Code 0322) were also surveyed. While there are only approximately 15 buyers in Code 022 who routinely procure P-3 parts, it was felt that since most buyers within the division bought airplane parts, exclusively, there would be sufficient recognition of the

items to be surveyed, (or similar items) to provide reasonable answers to the questionnaire.

Figure 3-1 contains the list of the P-3 unique items that were surveyed at ASO:

Sonar Data Control
Fairing, Tailpipe
Flap Assembly
Entry Ladder Tread
Aileron
Lavatory Mirror Frame
Accelerometer, Mechanical
Computer, True Airspeed
Radio Beacon
Wing Tip Red Light Lens
Seat, Toilet, Plastic
Oven Assembly, P-3 Galley
Door Assembly, Right Hand, Bomb Bay
P-3 Galley Refrigerator
Propeller, Aircraft, Variable Pitch
Radome Boom Assembly, MAD
Feather Override Button
Wheel Assembly, Nose Landing Gear

Figure 3-1 ASO Survey Items

The ASO survey is enclosed as Appendix B.

b. DGSC Items

The items to be surveyed at DGSC were selected based on a homogeneous grouping based on FSC. It was intended that two separate samples would be selected to increase the number of items used to validate the model. One group was to be from Procurement Division I, and one

group from Procurement Division II, in order to distribute the survey workload responsibilities. After a number of on-site discussions with DGSC personnel, Food Service Equipment (FSC Group 73) from Procurement Division I, and Ship and Marine Equipment (FSC Group 20) from Procurement Division II were chosen.

The Food Service Equipment Items (FSC Group 73) chosen are shown in Figure 3-2:

Bread Slicing Machine
Fork, Field Mess
Dishwashing Machine
Ice Maker, Flake
Dispenser, Bulk Milk
Oven, Microwave, Electric
Kettle, Steam Jacketed, Electric, 60 Gal.
Ice Cream and Shake Maker-Soft Serve/Refrigerated
Meat Slicer, Electric
Stove, Gasoline Burner
Filter, Coffee Urn
Saw, Band, Meat Cutting
Steam Table
Refrigerator, Pre-fabricated (Walk-in)
Rack, Dishwashing
Waffle Iron, Electric
Vegetable Peeler, Electric
Coffee Maker/Percolator

Figure 3-2 Food Service Equipment (DGSC) Survey Items

The survey for these items is enclosed as Appendix C.

The surveys for the above items were administered to Procurement Division I contracting personnel. This division is responsible for purchasing Food

Service Equipment for DGSC, although only about 15 of the 60 potential respondents routinely were required to purchase these items.

The other homogeneous grouping consisting of Ship and Marine equipment (FSC Group 20) contained the items shown in Figure 3-3:

Chair, Straight
Buoy Flag
Container, Trash
Ratguard, Ship
Tiedown Assembly
Anchor, Fluked, 750 Lbs
Landing Ship Bow Ramp
Console, Ship Control
Propeller
Rudder
Seat, Toilet, Plastic
Door, Watertight
Anchor, Mushroom, (4000 Lbs)
Buoy, Navigational
Marker, Nun
Stanchion Assembly
Hatch Restraint
Cathodic Rod
Desk, Flat Top

Figure 3-3 Ship/Marine Equipment (DGSC) Survey Items

This survey is enclosed as Appendix D.

These surveys were administered to Procurement Division II personnel, since ,as above, the responsibility for procuring these items rested in this division. Again,

not all respondents were expected to have had actual hands-on purchasing experience, but the items selected were of a nature that would allow easy name recognition of most if not all the items by each survey recipient.

3. Other Considerations

Several other considerations went into the administration of the survey. These included:

1. Time to Complete: Based on the relative ease in physically providing the data, as well as the limited number of items to be classified, the researcher estimated that the survey would require approximately 20-30 minutes to complete. This included time required to read the introduction and the characteristic descriptions.

2. Number of Surveys: Based on discussions with Lieutenant Colonel Daryl Johnson, USAF at DGSC, it was decided that 60 surveys would be forwarded for each procurement division. Similarly, after discussions with Lieutenant Commander Chris McKelvey, SC, USN at ASO, it was decided that 60 surveys would be provided for Code 022, with an additional 20 surveys for Code 0322.

3. Survey Administration: As agreed upon during the researcher's visit to both sites, the surveys would be forwarded to the division (branch) heads, who would administer the surveys to the buyers.

C. DATA GATHERING

Data gathering was conducted over a period of six weeks after the surveys were forwarded to the respective buying organizations. Although there was no effect on the outcome of the research effort, the survey responses were slow in coming back. Some of the causes of this delay could

include:

- Fiscal Year End: Conducting the surveys at the end of the fiscal year meant that they needed to compete with the higher than normal workload that is common during this time. However, there should have been sufficient opportunity once the year end work was complete to devote the less than one hour per person required to properly fill out the survey in a timely manner.

- Size of Survey: No doubt a factor as each survey was twelve pages long. However, filling out the form did not require a detailed analysis, but rather relied on the professional experience of the buyers, and their recognition of the items. Based on data from the respondents, the average time to complete the survey was 21 minutes.

- Buyers Felt Unqualified to Participate: A small number of buyers did not feel qualified to fill out the survey. Their sentiments as expressed through their supervisors indicated that they felt that were not technically qualified, or had insufficient experience with the item to make a rational classification judgement. However, this was purely anecdotal and the researcher did not pursue it as it was beyond the scope of the research.

Despite the relatively minor difficulties in filling out the surveys as mentioned above, there was a willingness on the part of many buyers at both activities to assist the researcher in his efforts. Where there were problems, phone calls between the researcher and individual buyers, and between the researcher and the supervisors helped to ameliorate any impediments.

D. CONCLUSION

This completes the description of how the raw data were collected for the research effort. A summary of the design of the information collection system was discussed, as well as a brief overview of some of the problems that occurred in conducting the survey. The next chapter will discuss, in detail, the analysis of the data, and will apply the taxonomic methods described by Wenger to the information assembled. A further discussion of the data collection obstacles, and potential solutions will be contained in Chapter V.

IV. DATA ANALYSIS

A. INTRODUCTION

Chapter II outlined the basic concepts underlying the use of taxonomic methods in the classification of goods procured by the Federal Government, while Chapter III discussed the collection of the data used to classify three homogeneous groups of goods. The purpose of this chapter is to analyze the data collected. A general introduction to the analysis techniques used by taxonomists will be included, as well as the specific methods of cluster analysis used to investigate the data collected on the three homogeneous groups of goods.

B. PROCEDURAL OVERVIEW

The purpose of this section is to provide a brief overview of the procedures used in analyzing the data received from the surveys conducted at the Navy Aviation Supply Office (ASO), Philadelphia, PA and the Defense General Supply Center (DGSC), Richmond, VA.

Upon receipt of the completed surveys, each was tabulated by characteristic, compiled on a single form and input into a LOTUS 1-2-3 database for each homogeneous group

of items. This database proved to be very useful in manipulating the data, and for the calculation of statistics such as the characteristic means and standard deviations. Once loaded into the database, the information was transferred into a SAS statistical program file. Again LOTUS proved to be a very practical tool since the information could be input directly into the SAS statistical program on the Naval Postgraduate School (NPS) mainframe computer from an IBM compatible personal computer (PC). Within SAS, cluster analysis of the data was conducted using the CLUSTER program. A complete discussion of the cluster analysis methods employed will be discussed in the next section. The resulting groupings produced by the cluster analysis were then analyzed and verified. A discussion of this detailed analysis will be included in a subsequent section.

C. CLUSTER ANALYSIS BACKGROUND AND TECHNIQUES

1. Cluster Analysis Background

There are a number of analysis techniques available to the numerical taxonomist. Of these, probably the most popular and useful is hierarchal cluster analysis. Cluster analysis is used in a variety of areas including biology, management, archeology and numerical taxonomy. A salient

feature of cluster analysis is that apart from being a very powerful analytic tool, it is relatively simple from a conceptual viewpoint. H. Charles Romesburg in his book **Cluster Analysis for Researchers** pointed out that:

> Cluster analysis is easily communicated. Its aims are directly and simply stated. Its language is ordinary arithmetic. And it is easily learned. It is one quantitative method everyone can do, and do well. (Romesburg, 1984, p.9)

Before proceeding further, it would be useful to define several common terms: (Romesburg, 1984, pp.314-317)

- Data Matrix- The input data to a cluster analysis.
- Resemblance Coefficient- Coefficient measuring the similarity (or dissimilarity) between a pair of objects.
- Resemblance Matrix- Matrix used to store the values of the resemblance coefficient for all pairs of objects.
- Cluster- A set of objects that are similar to each other.
- Clustering Method- The method that uses the resemblance matrix as its input and creates a tree showing the similarities among objects as its output. Such a method groups similar items into clusters.
- Dendogram- The main output of a hierarchal cluster analysis. The dendogram shows the hierarchy of similarities between all pairs of objects. Also called a "tree" or "phenogram".
- UPGMA Clustering Method- (Un-weighted pair-group method using weighted averages) A clustering method that forms clusters based on the average value of similarity between the two clusters being merged. Also called: "average linkage clustering method".
- Ward's Minimum Variance Clustering Method- A clustering method that assigns objects to clusters in such a way that a sum-of-squares index E is minimized.

As was mentioned in Chapter II, numerical taxonomy is a discipline that utilizes numerical methods to accomplish the classification of units into a taxonomic structure. One of the main purposes of a taxonomic structure is to achieve economy of memory. To that end Sokal and Sneath wrote:

> This economy is achieved in one of two ways: (1) either we employ the attributes one at a time in order to cluster our taxonomic entities, which gives us a system such as that used in indexing books by the names of their authors or by their size (monothetic systems), or (2) we attempt to cluster them according to all their attributes considered simultaneously, for which we use measures of affinity between the entities. (Sokal and Sneath, 1963, p.170)

Cluster analysis achieves this second system by the use of relatively uncomplicated mathematical algorithms which establish the natural taxa based on all the attributes of the unit. In addition to cluster analysis, numerical taxonomists use other multivariate methods such as factor analysis, multidimensional scaling, principal component analysis, and principal coordinate analysis. But cluster analysis is the method most often used.

> Unlike other multivariate methods that are based on mathematical deduction and expressed through matrix algebra, cluster analysis is an algorithmic series of steps that uses matrices for tidiness but does not use them for calculations.
>
> Because of the mathematical simplicity of cluster analysis, many assume it may be inferior to the other,

more complex multivariate methods. However, no scientific study has ever shown that "mathematical simplicity" equates to "inferiority" and that the more complex a method is the better it must be. (Romesburg, 1984, p.30)

The purpose of cluster analysis, therefore, is to group, through a number of mathematical methods, those objects in a given set that are similar. A number of different clustering methods have been developed, with differing definitions of clusters and differing approaches to the measurement of similarity among units. Given these differing approaches, several types of clusters are possible:

- Disjoint clusters place each object in one and only one cluster.
- Hierarchal clusters are organized so that one cluster may be entirely contained within another cluster, but no kind of overlap between clusters is allowed.
- Overlapping clusters can be constrained to limit the number of objects that belong simultaneously to two clusters, or they can be unconstrained, allowing any degree of overlap in cluster membership.
- Fuzzy clusters are defined by a probability or grade of membership of each object in each cluster. Fuzzy clusters can be disjoint, hierarchal or overlapping.

Wenger, in establishing the model for the taxonomy of goods, utilized the hierarchal clustering arrangement, specifically, the unweighted pair-group method using arithmetic averages (UPGMA) (more commonly known as the

average linkage method) and Ward's minimum variance method. (Wenger, 1990, p.59) These two procedures are the most commonly utilized methods of cluster analysis (Romesburg, 1984, p.52 and 159), and will be used exclusively by the researcher to classify the three homogeneous groupings of goods.

2. Cluster Analysis Methods

a. General

The basic hierarchal clustering process begins with **n** clusters (where **n** equals the number of items) each having one item in the cluster. The procedure then calls for merging the clusters with the most similar characteristics into a new cluster, that replaces the old pair. This continues stepwise until only one cluster is left, which contains all **n** items. Thus the number of clusters, ranges from 1 to **n**. One of the challenges, then for the numerical taxonomist is to determine the number of clusters to effectively represent the data.

The cluster analysis program used by the researcher was the CLUSTER procedure contained in the SAS system for data analysis. The CLUSTER program looks at the values from the data matrix and computes Euclidean distances. It is from these computed distances between

clusters that the similarity/dissimilarity decision is made.

b. Average Linkage Method

The average linkage method defines the distance between the clusters as the average distance between pairs of observations, one in each cluster. Average linkage tends to combine clusters with small variances and is slightly biased toward producing clusters with the same variance. Average linkage was originated by Sokal and Michener in 1958. (SAS User's Guide: Statistics, Version 5 Edition, 1985, p.263)

c. Ward's Minimum Variance Clustering Method

The second most common cluster analysis method, Ward's minimum variance method, seeks to join clusters based on minimizing the sum-of-squares. Specifically:

> In Ward's minimum variance method the distance between two clusters is the ANOVA sum of squares between the two clusters added up over all the variables. At each generation, the within-cluster sum of squares is minimized over all partitions obtainable by merging two clusters from the previous generation. The sums of squares are easier to interpret when divided by the total sum of squares to give proportions of variance.
>
> Ward's method tends to join clusters with a small number of observations and is strongly biased toward producing clusters with roughly the same number of observations. It is also sensitive to outliers. (SAS User's Guide: Statistics, Version 5 Edition, 1985, p.267)

There are a number of other methods available including the centroid method, the density method, single linkage (SLINK) and others. However, as mentioned before, average linkage and Ward's are the most popular, and on average produce less distortion in transforming the similarities into a hierarchal representation. (Romesburg, 1984, p.127 and 129)

D. CLUSTER ANALYSIS RESULTS

1. Establishment of an A Priori Prediction

A preliminary step in any cluster analysis is the establishment of an a priori prediction of the cluster analysis results based on the researcher's expectations. In commenting on cluster analysis, R. N. Sinha (1977) stated:

> Before the analysis the researcher should develop, in as much detail as possible, the structure of the solution he expects. Then he should compare it to the results of the analysis. A priori specification of a model gives a more objective benchmark than is provided by a posteriori rationalization or appeal. (Romesburg, 1984, p.258)

The establishment of an a priori model of the cluster analysis was conducted after the receipt of the surveys, but before the actual conduct of the data analysis. The researcher drew heavily on the concepts of classification proposed by Gordon Miracle (Miracle, 1965). As outlined in Chapter II, Miracle established five

groupings of goods. He placed goods in one of these five groups based on their characteristics. Similarly, Wenger in establishing the model for the classification of goods procured by the Government, established five groups, and also utilized Miracle's classification concepts in establishing his own a priori prediction.

In establishing the a priori prediction, the researcher used the results from the Government goods classificatory scheme established by Wenger as a benchmark to make a rough estimation of where the goods classified in this study would fall. The examples from the groups established by the Wenger study were:

- Group I Examples are: Sandpaper, Flat washer and Paper towel dispenser.
- Group II Examples are: Film projector, Micrometer and Washing machine.
- Group III Examples are: Microcomputer and Semi-conductor assembly.
- Group IV Example is: Floating Drydock.
- Group V Examples are: Fire control computer, Guided missile and Periscope.

Given the benchmarks established by both Miracle and Wenger, the researcher established the a priori predictions for each category of goods in Table 4-1. Five groupings were used, as this was considered to be a workable number of

groups, and is in consonance with the previously established classificatory schemes.

It should be noted that when the Food Service Equipment items are grouped relative to the benchmarks discussed above, there is a tendency for them to fall to the low or simple side of the spectrum. This is as one would expect, and is a function of using items from a homogeneous grouping. Relative to the group itself, there is sufficient dissimilarity in the items to array them across a continuum. However, when compared to all Government goods as a whole, homogeneous groupings such as food service equipment tend to bunch up in one location on the spectrum. This is a limitation of this study, that will be discussed in a subsequent chapter.

2. Cluster Analysis Results

In order to conduct the cluster analysis, three Tables of Means (one for each homogeneous grouping) were created from the LOTUS spreadsheet. The X-axis of each matrix represented the item characteristics, while the Y-axis represented the items themselves. These matrices were then established as SAS data sets on the NPS mainframe.

As previously mentioned, the data sets were analyzed using the CLUSTER program in SAS. The SAS programs, while not very user-friendly to the neophyte, proved to be an

TABLE 4-1
A PRIORI PREDICTIONS OF CLUSTER ANALYSIS RESULTS

P-3 ORION ITEMS (ASO)	SHIP/MARINE ITEMS (DGSC)	FOOD SERVICE ITEMS (DGSC)
Category I	**Category I**	**Category I**
Lavatory Mirror Frame	Trash Container	Coffee Filter
Toilet Seat	Toilet Seat	Dishwasher Rack
Ladder Tread	Buoy Flag	Fork, Mess
Category II	**Category II**	**Category II**
Red Light Lens	Chair, Straight	Waffle Iron
Feather Override Button	Ratguard	Coffee Maker
Oven Assembly	Desk	Meat Slicer
	Tiedown Assy	
Category III	**Category III**	**Category III**
Tailpipe Fairing	Anchor, Fluked	Vegetable Peeler
Aileron	Stanchion Assy	Microwave Oven
Leading Edge	Buoy, Navigation	Bread Slicer
Door Assembly	Hatch Restraint	Meat Band Saw
Flap Assembly	Rudder	Steam Table
Refrigerator	Cathodic Rod	Stove, Gasoline
	Anchor, Mushroom	Ice Maker
Category IV	Watertight Door	Ice Cream Maker
Accelerometer	Propeller	Milk Disp
Radio Beacon		Dishwashing Machine
Wheel Assembly	**Category IV**	Steam Kettle
Propeller	Landing Ship Bow Ramp	
Category V	**Category V**	**Category IV**
Computer, Airspeed	Ship Control Console	Walk-in Refrig
Sonar Data Control		
Radome Boom		

invaluable tool in conducting the analysis. The data were analyzed for each activity independently, and were also analyzed in the aggregate. The output from the SAS CLUSTER program provided a history of the clustering sequence and a dendogram. The dendogram was then cut at the level required to generate five clusters of items.

a. Number of Clusters

There are no specific rules for determining a "correct" number of clusters to use. However, using just one cluster with n items in it, or n clusters, each having one item in it, provide no meaningful insight into the nature of the items being observed as a part of the classification process. It is therefore, left to the judgment of the numerical taxonomist to determine a proper number of clusters, somewhere between these two extremes. The SAS Statistics guide states:

> There are no satisfactory analytical methods for determining the number of population clusters for any type of cluster analysis. (SAS User's Guide: Statistics, Version 5 Edition, 1985, p.65)

Wenger in establishing the taxonomic model cited the reference above, and established five clusters as the ideal for this process, because of the number of inputs and the small change in results when the number of clusters were changed to four or six. The researcher concurred with this

observation, noting that the choice of the number of clusters in the four to six range, had little significant affect on where the items would be classified. Since both Miracle, in establishing the groupings of goods, and Wenger in establishing the taxonomic model being validated, used five clusters or groups, this level of clusters was adopted for this thesis.

Furthermore, the use of five clusters has an intuitive appeal. This level provides sufficient differentiation in the classes, while keeping the schema relatively simple.

b. Cluster Analysis Results By Group

In general, the clusters produced by the two hierarchal methods were very similar. In some cases, particularly when using average linkage method, a cluster would end up with only one member good. Ward's Mean Variance method on the other hand, provided clusters with relatively even numbers of members, as would be expected given the method's sensitivity to outliers. (SAS User's Guide: Statistics, Version 5 Edition, 1985, p.267)

Brian Wenger in establishing the model, gave preference to the Average linkage method of cluster analysis. His decision was based on the relative popularity

of the method, and the fact that for his data, the results for both methods were approximately the same. He stated:

> Before continuing with the analysis, the researcher made the decision to use only one clustering method rather than two. Since both clustering methods produced the same results, the researcher decided to use average linkage for future clustering iterations and testing. Because of its popularity among researchers and the reasonable output, it appeared to be the most logical choice. (Wenger, 1990, p.62)

At this point the researcher diverged slightly from the path set by Wenger, and use Ward's Minimum Variance method as the primary clustering procedure. The method's tendency to provide even sized clusters, as well as its treatment of the outliers in the observation set, make it appealing to the researcher for this project. A main goal is to be able to group the items with similar goods, for the purpose of classifying the items. Establishing single item clusters does not support the purpose of this endeavor. In most cases, however, the results for the average linkage method, as well as Ward's method will be shown.

The results of the cluster analysis are presented in Tables 4-2 through 4-4. The information is presented in a side by side format to allow for comparison of the Average-linkage method, Ward's minimum variance method and the <u>a priori</u> prediction. The three digit number in the header of each category represents the average value of the means for the goods within the cluster. This figure

was used to array the clusters along the spectrum from low to high.

The analysis of the P-3 ORION clustering results, indicated a high level of correlation between the two clustering methods, and the a priori prediction. In using the average linkage method, one cluster ended up with only one item in it, while the Ward's method produced clusters with more consistently sized populations.

The cluster analysis for the food service equipment also showed a correlation with the a priori prediction. The coffee filter was the single element of a cluster under both methods. An analysis of the data indicated that it was considered to be significantly simpler than the other goods analyzed, making it an outlier in either case.

The results from the analysis of the ship/marine equipment produced similar results. While in general correlation with the a priori prediction, there was some movement of items between clusters from one method to another. The differences were not considered significant, and merely reflected the different clustering approach between the two methods.

TABLE 4-2
P-3 ORION (ASO) Cluster Analysis Results

Average Linkage	Ward's Minimum Variance	A Priori Prediction
Cluster 1 - 2.15	Cluster 1 - 2.15	Category 1
- Lavatory mirror frame	- Lavatory mirror frame	- Lavatory mirror frame
- Toilet seat	- Toilet Seat	- Toilet seat
- Ladder tread	- Ladder tread	- Ladder tread
Cluster 2 - 2.53	Cluster 2 - 2.53	Category 2
- Red light lens	- Red light lens	- Red light lens
- Feather override button	- Feather override button	- Feather override button
Cluster 3 - 3.32	Cluster 3 - 3.25	- Oven assembly
- Oven assembly	- Oven assembly	
- Tailpipe fairing	- Tailpipe fairing	Category 3
- Aileron	- Aileron	- Tailpipe fairing
- Leading edge	- Leading edge	- Aileron
- Flap assembly	- Door assembly	- Leading edge
- Refrigerator	- Flap assembly	- Door assembly
- Wheel assembly	- Refrigerator	- Flap assembly
- Propeller	- Wheel assembly	- Refrigerator
- Accelerometer	- Propeller	
- Radio beacon		Category 4
- Computer, airspeed	Cluster 4 - 3.54	- Accelerometer
	- Accelerometer	- Radio beacon
Cluster 4 - 3.36	- Radio beacon	- Wheel assembly
- Door assembly	- Computer, airspeed	
Cluster 5 - 3.94	Cluster 5 - 3.94	Category 5
- Radome boom	- Radome boom	- Radome boom
- Sonar data control	- Sonar data control	- Computer, airspeed
		- Sonar data control

TABLE 4-3
FOOD SERVICE EQUIPMENT (DGSC) CLUSTER ANALYSIS RESULTS

Average Linkage	Ward's Minimum Variance	A Priori Prediction
Cluster 1 - 1.77	Cluster 1 - 1.77	Category 1
- Coffee filter	- Coffee filter	- Coffee filter
		- Fork, mess
Cluster 2 - 2.13	Cluster 2 - 2.18	- Dishwasher rack
- Fork, mess	- Dishwasher rack	
	- Fork, mess	
Cluster 3 - 2.69		Category 2
- Bread slicer	Cluster 3 - 2.73	- Waffle iron
- Ice maker	- Bread slicer	- Coffee maker
- Meat band saw	- Ice maker	- Meat slicer
- Milk Disp	- Meat band saw	
- Ice cream maker	- Milk disp	Category 3
- Steam kettle	- Coffee maker	- Microwave oven
- Meat slicer	- Ice cream maker	- Vegetable peeler
- Steam table	- Steam kettle	- Bread slicer
- Waffle iron	- Meat slicer	- Meat band saw
- Vegetable Peeler	- Steam table	- Steam table
- Dishwasher rack	- Waffle iron	- Stove, gasoline
- Coffee maker	- Vegetable peeler	- Ice maker
		- Ice cream maker
Cluster 4 - 3.01	Cluster 4 - 3.01	- Milk disp
- Dishwashing machine	- Dishwashing machine	- Dishwashing machine
- Microwave oven	- Microwave oven	- Steam kettle
Cluster 5 - 3.10	Cluster 5 - 3.10	Category 4
- Stove, gasoline	- Stove, gasoline	- Walk-in refrigerator
- Walk-in refrigerator	- Walk-in refrigerator	

TABLE 4-4
SHIP/MARINE EQUIPMENT (DGSC) CLUSTER ANALYSIS RESULTS

Average Linkage	Ward's Minimum Variance	A Priori Prediction
Cluster 1 - 2.13 - Toilet seat - Trash container - Chair, straight - Desk	Cluster 1 - 2.13 - Toilet seat - Trash container - Chair, straight - Desk	Category 1 - Toilet seat - Trash container - Buoy flag
Cluster 2 - 2.86 - Buoy flag - Anchor, fluked - Anchor, mushroom - Ratguard - Stanchion assy	Cluster 2 - 2.88 - Buoy flag - Anchor, fluked - Anchor, mushroom	Category 2 - Chair, straight - Desk - Tiedown assy - Ratguard
Cluster 3 - 3.20 - Tiedown assy - Propeller - Buoy, navigation - Rudder - Watertight door	Cluster 3 - 3.08 - Tiedown assy - Propeller - Buoy, navigation - Hatch restraint	Category 3 - Anchor, fluked - Anchor, mushroom - Hatch restraint - Propeller - Buoy, navigation - Stanchion assy - Rudder - Watertight door - Cathodic rod
Cluster 4 - 3.23 - Hatch restraint	Cluster 4 - 3.14 - Stanchion assy - Rudder - Watertight door - Ratguard	Category 4 - Landing ship bow ramp
Cluster 5 - 3.73 - Landing ship bow ramp - Cathodic rod - Ship control console	Cluster 5 - 3.73 - Landing ship bow ramp - Cathodic rod - Ship control console	Category 5 -Ship control console

c. Cluster Analysis of All Items Sampled

One of the perceived shortcomings of clustering items within homogeneous groupings is that while it is possible to come up with five distinct clusters which can be placed along a spectrum from simple to complex, the results do not reflect the relative relationship to the other goods procured by the Federal Government. Food service equipment, for instance, when examined only within its own group has a significant difference from the low end (coffee filters) to the high end (walk-in refrigerators). This comparison is relative only to the items in the group, ignoring all other groups of items in the universe of goods.

The ultimate goal of a classification of goods procured by the Federal Government is to classify all (or nearly all) possible candidates. While impractical in this project, the researcher felt it would be illustrative to cluster all the goods sampled together. This would remove the bias caused by ranking the goods on a relative basis within one homogeneous grouping, and would point out any counterintuitive classifications.

While not all items were classified by the same individuals, the nature of the model in using the inherent characteristics of the good, should not be dependent on the individuals completing the survey, and when taken in

aggregate should produce valid results. The results of this cluster analysis (Ward's method) are shown in Table 4-5.

The dendogram resulting from the clustering of all the items together, showed a good mixture of items at the high and low ends. In the middle clusters, the items clustered in approximately (although not exclusively) their same groups.This is as you would expect, since the point of the classification effort is to categorize the goods based on their inherent characteristics. We will see in the next chapter that improvements can be made by streamlining the model through the elimination of some of the characteristics. This streamlining will take place , both to make it easier for buyers to provide the data, and to eliminate some of the characteristics that are less useful to the classification process.

E. CONCLUSION

This chapter presented an analysis of the classification data, using the taxonomic model established by Wenger. The data were cluster analyzed by group, and in the aggregate. The classifications produced provide insight concerning the relationship between an individual good and the universe of goods by establishing a relative grouping for it. If, as postulated earlier, the objective of classification is to

TABLE 4-5
CLUSTER ANALYSIS OF ALL GOODS SAMPLED

Cluster 1 (2.09)

Chair	Toilet Seat	Coffee Filter
P-3 Toilet Seat	Mirror frame	Dishwasher rack
Trash Container	Ladder Tread	

Cluster 2 (2.78)

Desk	Vegetable peeler	Milk dispenser
Steam kettle		Coffee maker
Meat slicer	Bread slicer	Ice cream maker
Steam table	Ice maker	Stove, gasoline
Waffle iron	Meat band saw	Refrigerator, Walk-in
Microwave oven	Dishwasher	

Cluster 3 (2.86)

Buoy flag	Hatch restraint	Anchor, fluked
Propeller	Stanchion assy	Anchor, mushroom
Fork, mess	Ratguard	
Tiedown assy		

Cluster 4 (3.18)

P-3 oven assy	Accelerometer	Flap
Buoy, nav	Radio beacon	Feather O/R button
P3 refrigerator	Wheel assy	
P-3 propeller	Leading edge	Fairing
Airspeed computer	Red light lens	Aileron

Cluster 5 (3.67)

Landing ship bow ramp	P-3 sonar control	Ship control console
Cathodic rod	Radome	Door, Water-tight
P-3 door assy	Rudder	

facilitate ease of memory, then the use of the procedures established by the taxonomic model is a success. Given the information that a good has been placed in one of the five categories allows the user (buyer) to understand something about the item without knowing about it specifically.

The model is not perfect, however, and improvements can be made by reducing the number of categories. This was recognized by Wenger, and similarly addressed. The next chapter will address these recommended improvements, apply the goods to the six characteristic scheme and discuss potential applications of the process.

V. IMPROVING THE SCHEME

A. INTRODUCTION

Chapter IV applied the taxonomic model across all twelve characteristics to the 56 goods surveyed as a part of this research. The next step is to attempt to modify the scheme to eliminate those characteristics which do not contribute significantly to the classification effort, while at the same time streamline the process to make it easier to collect data. This chapter will first examine those characteristics eliminated by Wenger, and show the attendant affect on the clustering results. The goods will then be applied to the classification scheme using the remaining characteristics. Finally, several areas of application of the classification process will be discussed.

B. MODIFYING THE MODEL

1. Removing Characteristics

In assessing the essentiality of an attribute to the classification scheme, Romesburg pointed out that:

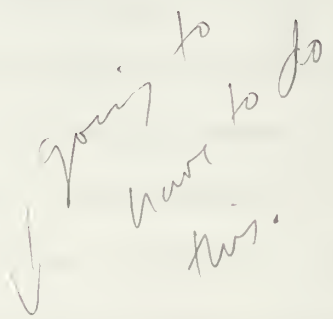
> ...if an attribute whose mean was about the same across all clusters, it would be an inessential attribute and could be removed from the analysis. Conversely, an attribute that drives the clustering must show a large difference in its mean value (relative to the standard

deviations) across two or more clusters. (Romesburg, 1984, p. 273)

Wenger employed this methodology in determining which attributes to remove from the classification scheme. In order to examine the effect of this methodology for application in this particular research, the same six attributes were removed. The rationale for characteristic removal is presented later in this chapter.

The characteristics that were retained are:

- Complexity
- Customization
- Maintainability
- Unit cost
- Documentation
- Item attention



The goods classified in this research were then reclassified using these six attributes. The results of this cluster analysis are included as Table 5-1 (P-3 ORION items), Table 5-2 (Food services equipment) and Table 5-3 (Shipboard and marine goods). The clustering results using Ward's method with the revised number of characteristics, the results for all characteristics and the a priori predictions are provided in side by side format to facilitate comparison.

TABLE 5-1
P-3 ORION (ASO) CLUSTER ANALYSIS RESULTS (REVISED)

Ward's Minimum Variance Six Attributes	Ward's Minimum Variance All Attributes	A Priori Prediction
Cluster 1 - 1.95 - Lavatory mirror frame - Toilet seat - Ladder tread	Cluster 1 - 2.15 - Lavatory mirror frame - Toilet Seat - Ladder tread	Category 1 - Lavatory mirror frame - Toilet seat - Ladder tread
Cluster 2 - 2.88 - Red light lens - Feather override button - Refrigerator - Oven assembly - Tailpipe Fairing - Aileron	Cluster 2 - 2.53 - Red light lens - Feather override button	Category 2 - Red light lens - Feather override button - Oven assembly
Cluster 3 - 3.36 - Door assembly - Flap assembly	Cluster 3 - 3.25 - Oven assembly - Tailpipe fairing - Aileron - Leading edge - Door assembly - Flap assembly - Refrigerator	Category 3 - Tailpipe fairing - Aileron - Leading edge - Door assembly - Flap assembly - Refrigerator
Cluster 4 - 3.60 - Leading edge - Wheel assembly - Propeller - Accelerometer - Radio beacon	Cluster 4 - 3.54 - Accelerometer - Radio beacon - Computer, airspeed	Category 4 - Accelerometer - Radio beacon - Wheel assembly
Cluster 5 - 4.15 - Radome boom - Sonar data control - Computer, airspeed	Cluster 5 - 3.94 - Radome boom - Sonar data control	Category 5 - Radome boom - Computer, airspeed - Sonar data control

TABLE 5-2
FOOD SERVICE EQUIPMENT (DGSC) CLUSTER ANALYSIS (REVISED)

Ward's Minimum Variance Six Attributes	Ward's Minimum Variance All Attributes	A Priori Prediction
Cluster 1 - 1.89	Cluster 1 - 1.77	Category 1
- Coffee filter	- Coffee filter	- Coffee filter
- Fork, mess		- Fork, mess
- Dishwasher rack	Cluster 2 - 2.18	- Dishwasher rack
	- Dishwasher rack	
Cluster 2 - 2.80	- Fork, mess	Category 2
- Bread slicer		- Waffle iron
- Ice maker	Cluster 3 - 2.73	- Coffee maker
- Meat band saw	- Bread slicer	- Meat slicer
- Milk disp	- Ice maker	
- Coffee maker	- Meat band saw	Category 3
- Steam kettle	- Milk disp	- Microwave oven
- Stove, gasoline	- Coffee maker	- Vegetable peeler
- Steam table	- Ice cream maker	- Bread slicer
- Waffle iron	- Steam kettle	- Meat band saw
- Vegetable Peeler	- Meat slicer	- Steam table
	- Steam table	- Stove, gasoline
Cluster 3 - 3.03	- Waffle iron	- Ice maker
- Ice cream maker	- Vegetable peeler	- Ice cream maker
- Microwave oven		- Milk disp
	Cluster 4 - 3.01	- Dishwashing machine
Cluster 4 - 3.22	- Dishwashing machine	- Steam kettle
- Meat slicer	- Microwave oven	
- Walk-in refrigerator		Category 4
	Cluster 5 - 3.10	- Walk-in refrigerator
Cluster 5 - 3.37	- Stove, gasoline	
- Dishwashing machine	- Walk-in refrigerator	

TABLE 5-3
SHIP/MARINE EQUIPMENT (DGSC) CLUSTER ANALYSIS (REVISED)

Ward's Minimum Variance Six Attributes	Ward's Minimum Variance All Attributes	A Priori Prediction
Cluster 1 - 2.09	Cluster 1 - 2.13	Category 1
- Toilet seat	- Toilet seat	- Toilet seat
- Trash container	- Trash container	- Trash container
- Chair, straight	- Chair, straight	- Buoy flag
- Desk	- Desk	
- Buoy flag		Category 2
- Ratguard	Cluster 2 - 2.88	- Chair, straight
	- Buoy flag	- Desk
Cluster 2 - 3.11	- Anchor, fluked	- Tiedown assy
- Anchor, fluked	- Anchor, mushroom	- Ratguard
- Anchor, mushroom		
- Tiedown assy	Cluster 3 - 3.08	Category 3
- Stanchion assy	- Tiedown assy	- Anchor, fluked
- Hatch restraint	- Propeller	- Anchor, mushroom
- Buoy, navigation	- Buoy, navigation	- Hatch restraint
	- Hatch restraint	- Propeller
Cluster 3 - 3.48		- Buoy, navigation
- Propeller	Cluster 4 - 3.14	- Stanchion assy
- Rudder	- Stanchion assy	- Rudder
	- Rudder	- Watertight door
Cluster 4 - 3.67	- Watertight door	- Cathodic rod
- Watertight door	- Ratguard	
- Landing ship bow ramp		Category 4
- Cathodic rod	Cluster 5 - 3.73	- Landing ship bow ramp
	- Landing ship bow ramp	
Cluster 5 - 4.22	- Cathodic rod	Category 5
- Ship control console	- Ship control console	-Ship control console

As would be expected, there was some movement between clusters caused by the reduction of the number of attributes. In most instances, the change involved the movement of an item from one cluster to an adjacent cluster. Additionally, the results from the analysis using the six attributes yielded results that were more in line with the a priori prediction. One possible reason for this is that some of the attributes discarded provided skewed data. For instance, for the characteristic homogeneity, the average standard deviation of the responses given was 1.27, which on a scale ranging from 1-5 is abnormally high. This indicates that for this characteristic the respondents were confused about the definition, and the scaling criteria. Wenger also pointed this out stating:

> The next characteristic targeted for removal was "homogeneity". It, like "consumption" exhibited interpretational difficulties given the high degree and frequency in scoring variability.

As a side note, the problems with homogeneity were not limited to one group of respondents, as the average item standard deviation for this characteristic for ASO (P-3 ORION) items was 1.26. For both food service, and ship and marine items, the homogeneity standard deviation was 1.27. The rationale for eliminating attributes will be further discussed in a subsequent section.

An additional table, Table 5-4, shows the results of clustering all the goods simultaneously. Again it was illustrative to see how the individual groups of goods clustered relative to all the items sampled.

2. Validating the Attribute Removal Criteria

As was previously mentioned, it is desirable to remove from the cluster analysis those characteristics which do not contribute to the differentiation of the items to ensure that the analysis is robust. An ancillary benefit of this characteristic removal, is that it simplifies the data collection and analysis effort. The purpose of this section is to review and validate the criteria used by Wenger in arriving at the six characteristic scheme.

The removal of characteristics was accomplished by comparing the range of means for each attribute across each cluster. In accordance with Romesburg, those attributes whose range of means is approximately the same across the clusters may be inessential. (Romesburg, 1984, p. 273) The means for each characteristic were calculated across each cluster, and a range determined. Those characteristics with small ranges across the cluster means were identified as candidates to be eliminated. Table 5-5 provides the detailed results for the data obtained in this study. As indicated, the attributes with the highest ranges are:

Table 5-4
CLUSTER ANALYSIS OF ALL GOODS SAMPLED (REVISED)

Cluster 1 (2.13)

Chair	Toilet Seat	Coffee Filter
P-3 Toilet Seat	Mirror frame	Dishwasher rack
Trash Container	Ladder Tread	Fork, mess
Buoy flag	Desk	Ratguard
Red light lens	Tiedown assy	

Cluster 2 (2.98)

Steam kettle	Vegetable peeler	Milk dispenser
Feather O/R button	Bread slicer	Coffee maker
Steam table	Ice maker	Ice cream maker
Waffle iron	Meat band saw	Stove, gasoline
Microwave oven	Anchor, fluked	Buoy, nav
Fairing	Stanchion assy	Aileron
P-3 oven assy	P3 refrigerator	Anchor, mushroom
Hatch restraint	Rudder	Propeller

Cluster 3 (3.37)

Flap assy	Door assy	Refrigerator, Walk-in
Landing ship bow ramp	Meat slicer	

Cluster 4 (3.68)

Cathodic rod	Accelerometer	Door, Water-tight
P3 propeller	Radio beacon	Dishwasher
Leading edge	Wheel assy	

Cluster 5 (4.16)

Computer, airspeed	P3 sonar control	Ship control console
Radome		

	Clusters					
	1	2	3	4	5	Range
C1	1.67	2.39	1.70	2.52	2.76	1.09
C2	1.56	2.69	2.19	2.88	3.57	2.01
C3	2.33	2.59	3.65	3.43	4.39	2.06
C4	1.48	2.57	2.09	2.92	3.46	1.98
C5	2.35	2.47	3.54	3.55	4.12	1.77
C6	3.15	3.72	3.46	3.38	4.06	0.91
C7	2.18	3.02	3.34	3.60	4.22	2.04
C8	1.92	3.16	2.58	3.51	4.05	2.13
C9	2.05	3.19	2.97	3.33	3.93	1.88
C10	2.56	2.84	3.23	3.59	3.83	1.27
C11	1.49	1.93	2.55	2.89	3.18	1.69
C12	2.24	2.75	3.01	2.81	3.36	1.12

C1 = Change
C2 = Complexity
C3 = Customization
C4 = Maintainability
C5 = Homogeneity
C6 = Consumption

C6 = Consumption
C7 = Unit Cost
C8 = Documentation
C9 = Item Attention
C11= Criticality
C12= Stability

Table 5-5
AVERAGE ATTRIBUTE VALUE PER CLUSTER

complexity, customization, maintainability, unit cost, documentation and item attention. This is in full agreement with the characteristics chosen for retention by Wenger, confirming the choice of attributes to remove. While there was some movement of goods between clusters, the migrations were not significant, and the clusters achieved by the six attribute clustering were in closer agreement with the researcher's predictions. Romesburg points out that a secondary validity check is the "agreement with the researcher's prior expectations". (Romesburg, 1984, p.258)

Another secondary validity check is to demonstrate stability and robustness. The addition or deletion of a small amount of information (such as adding an attribute) should not produce major changes in the classification. (Romesburg, 1984, p. 258)

To explore this validity check, the researcher replicated the cluster analysis with two additional characteristics. The characteristic, homogeneity and criticality, had the next smallest ranges across the means as described above. The addition of these characteristics did not produce a significant shift in the clustering results. Since a goal of the streamlining was simplification, the researcher elected to leave the number of characteristics at six.

C. APPLYING THE DATA TO THE RESULTANT CLASSIFICATORY SCHEME

A major goal of this study is to validate the classificatory scheme developed by Wenger. This procedure incorporated the basics of cluster analysis in such a way as to allow it to be readily applied to all Government goods with a minimum of effort. Under this scheme, ranges correlating to the means of the attribute scores would be assigned to categorical labels extending from simple to complex. The values of the ranges were established artificially by dividing the scalar distance between 1 and 5 into five sections. The widths of each range were therefore set at .8.

Descriptive labels were also assigned. The relationship between the numerical ranges and the categorical labels is as follows:

1.00-1.80	Simple
1.81-2.60	Basic
2.61-3.40	Moderate
3.41-4.20	Advanced
4.21-5.00	Complex

1. Classification Results

The next step in the analysis involved classifying the goods in accordance with the process described above.

The results of categorizing the items using the Government goods classification scheme are shown in Table 5-6.

The resulting classification was similar to the cluster analysis using the six attributes, as was expected. The classifications from the two schemes were not identical, nor should they be. Romesburg astutely points out:

> For numerical taxonomy, as well as for other research goals, cluster analysis is used as a descriptive method for gauging the similarities of objects in a sample. Usually the sample is chosen nonrandomly for its interest. Any conclusions the researcher ascribes to the larger population from which the sample was obtained must be based on analogy, not inferential statistics. (Romesburg, 1984, p. 30)(Italics added for emphasis by researcher.)

Given this philosophy toward cluster analysis results, the results from the Government goods classification scheme are simply to be validated on an inferential basis, and not compared directly for differences.

In reviewing the Government goods classification scheme, the results are logical. As validated by the cluster analysis, items such as the coffee filter and the P-3 lavatory mirror were at the simple end of the scale, while the sonar data control and the ship control console were at the high end with the other items arrayed between.

The results were also reasonable in that when arranging the categories in a frequency chart, they formed a

Table 5-6
CLASSIFICATION RESULTS USING THE GOVERNMENT GOODS CLASSIFICATION SCHEME

SIMPLE (1.00-1.80)		
Mirror frame	Coffee filter	Toilet seat
BASIC (1.81-2.60)		
Fork, mess	Chair	Feather O/R button
Trash container	Desk	Waffle iron
Ladder tread	P-3 Toilet seat	Vegetable peeler
Buoy flag	Red light lens	Ratguard
Dishwasher rack	Coffee maker	
MODERATE (2.61-3.40)		
Tiedown assy	Meat slicer	Stove, gasoline
Bread slicer	Buoy, nav	Aileron
Meat band saw	Microwave oven	Hatch restraint
Steam table	Ice cream maker	Flap assy
Milk dispenser	Ice maker	Leading edge
Fairing	P-3 oven assy	Refrigerator, P-3
Steam kettle	Stanchion assy	
Anchor, fluked	Dishwasher	
ADVANCED (3.41-4.20)		
Propeller	Rudder	Landing ship bow ramp
Anchor, mushroom	Accelerometer	P-3 propeller
Door assy	Cathodic rod	Computer, air speed
Refrigerator, walk-in	Door, Water-tight	Radome
Radio beacon	Wheel assy	
COMPLEX (4.21-5.00)		
Ship control console	Sonar data control	

perfect "bell curve". This was similarly a logical outcome, since for the universe of items procured by the Government, goods are rarely at either end of the spectrum, but tend toward the center. For the sample of goods taken in this research, there was sufficient diversity to replicate, by analogy, this feature of the total population.

Based on these findings, the researcher therefore concludes that the scheme established for the classification of Government goods is valid, and can be a useful tool in procurement.

D. ADDITIONAL COMMENTS ON THE CLASSIFICATION SCHEME

The purpose of this section is to comment on some improvements to the entire classification scheme , and process. Included will be comments concerning data collection, characteristics and their scales, and the numerical ranges used in the classification scheme itself.

1. Characteristics and Scales

All six characteristics chosen for the classification scheme were reviewed to ensure that they were worded properly to avoid ambiguity, and to ensure that the associated scales were properly structured to ensure differentiation between products. Of the six characteristics (complexity, customization, maintainability,

unit cost, documentation and item attention) only unit cost as being a candidate for change.

The characteristic scale descriptions provided in the scheme are nominal scales, whereas unit price can be measured on a ratio scale (i.e. where zero is an absolute value). Given a list of items, the concept of very low unit cost and very high unit cost (as well as the levels in between) are relative to the items in the list. For further applications of the classificatory scheme it may be appropriate to provide the respondents with an absolute definition of what very low unit cost is (for instance: less than $1000) and what very high unit cost is (for instance: greater than $500,000), as well as absolute levels for the descriptions in between.

2. Classification Scheme Categorical Ranges

In establishing the values for assignment to the categorical labels, Wenger made an arbitrary decision to use equal size ranges. The problem with this is having goods in the highest and lowest categories is difficult, as the probability of achieving 1 or 5 approaches zero asymptotically. This means that very few items will end up in the high/low categories.

The researcher pondered making the ranges for categories 1 and 5 larger, while making the middle ranges

proportionally smaller. This would tend to give five categories with approximately the same number of members. (Much like Ward's cluster analysis method.) However, the researcher feels that the scheme as it stands provides for the best analog of the actual dispersion of items across the spectrum from simple to complex. Few items are at either end in reality, with most items falling somewhere in the middle.

3. Data Collection

As with most research efforts of this type, collection of the raw data was the most difficult and time consuming portion of the project. The researcher underestimated the amount of time it would take to receive the completed surveys.

a. Problems

(1) Nomenclature as the Item Recognition Tool

One of the potential problems perceived by the researcher in collecting the data, was the use of nomenclature as the sole identifier of the good. The choice of nomenclature only as the identification driver was made early in the research effort and reflected a desire to avoid inducing an *a priori* bias in the identification process. Unfortunately, using nomenclature only, was a two edged sword in that it left the identification of the good up to

the interpretational capabilities of the respondent. The problem here was less of an inability to identify the item, but rather it required the respondent to exert more effort in completing the survey. Based on the responses, the use of nomenclature that was significantly recognizable, as it was in this case, did not adversely affect the data.

However, not all items procured by the Federal Government are readily identifiable from their names, and a system of data collection that ameliorates this problem needs to be developed.

(2) Respondent Reluctance

At the outset of the data collection effort, there appeared to be a fair amount of reluctance on the part of the buyers to complete the surveys. Some respondents felt that they could not give a "right" or "correct" answer because they did not know what the items were, despite having bought them in the past. This indicated that they thought of the survey as a "test" that they needed to pass. Only after several telephone discussions with supervisors at both ASO and DGSC, stressing that the researcher was only interested in the opinion of the buyers as contracting professionals, and that there were no right or wrong answers, did the surveys get completed in sufficient numbers.

There were some anecdotal indications that the buyers were unfamiliar with the items that they were supposed to be purchasing. This is a disconcerting thought, but it remains conjectural, and was not fully pursued as it was outside the purview of the project. A fertile area for further research would be to sample what buyers do know about the items they are contracting for.

b. Potential Solution

One possible solution to both of the data collection problems mentioned above would be to develop a "push" type of data collection system. In the project described in this thesis, the researcher attempted to "pull" the data from the buyers. The result was, to the casual observer, a prohibitively large survey instrument, that the respondents would need to fill out cold (i.e. not necessarily working with the item in the recent past).

Under a "push" type system, the buyer would fill out the characteristics opinion sheet at some prearranged time in the buying cycle (probably at time of award), and forward the information to a data collection point. A system such as this would be similar to the way the Navy collects maintenance data from organizational maintenance units.

The advantages of a "push" type data collection scheme would go directly towards answering the problems listed above. The buyers would have recent experience with the goods since they are currently involved with procuring the item at the time of data submission. Also there would be no ambiguity about the item for which the data are being submitted, since it would probably be tied to a National Stock Number (NSN), part number or some other uniquely identifying means.

There are also several problems associated with the "push" type scheme. The data would come in slowly, one data point at a time. This would be fine for high buying velocity items, but the items bought on an infrequent basis would end up with insufficient data to apply them to the Government goods classification scheme. Another problem is that a collection point, and associated data base, would need to be established. The collection of the data from all buying activities for all items would be a massive effort. (Although, it would serve as the means to classify all goods procured by the Federal Government). A more limited method, for the purpose of procurement research, would be to collect data for discrete groups of items, or collect data for one buying activity only.

E. CONCLUSION

This chapter looked at streamlining the model through the removal of noncontributing characteristics. The methods for removal established by Wenger were validated, and the remaining characteristics were used in the Government goods classification scheme. The results from classifying the goods using the cluster analysis were then compared to the results from classifying the goods using the Government goods classification scheme, and found to be in general agreement. Finally, several observations on various details of the process including characteristic scales, categorical ranges and data collection were made.

The next chapter will provide conclusions and recommendations for this research effort.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The previous chapters outlined the use of taxonomic methods in classifying goods procured by the Federal Government. The purpose of this chapter is to suggest potential uses for the classification scheme, outline the conclusions of the researcher, review the primary and subsidiary research questions and provide recommendations for further research.

B. POTENTIAL APPLICATIONS

There are several practical applications for the classification scheme outlined in the research:

1. Workload Management

Segregation of items within the type of commodity can provide recognition by decision makers on the amount of effort required to make a purchase for an item. This information can be used for workload balancing, as well as for matching personnel strengths with complexity of buys.

2. Policy Formulation

Results of a classification scheme can be used to assist in the formulation of contracting laws, regulations

and procedures. Certain groups of items can be singled out for greater or lesser regulatory attention based on their characteristics as determined by the taxonomic scheme. This would help preclude viewing all Government goods as one amorphous mass when writing rules, laws and procedures.

3. Commercial Products Identification

This application is both useful and timely given the Government's policy of increased usage of commercial products. Certain groups of items can be identified, based on their characteristics, to be particularly well suited for procurement under commercial product acquisition initiatives. By readily identifying a good's characteristics, commercial product substitutes for Government goods may become more apparent.

4. Productive Unit Resourcing

As buying activities within the Department of Defense move toward a system that provides resources based on actual work performed, there is a need to equitably calculate the proper level of funding. For example, the Naval Supply Systems Command field contracting activities use a budgeting program known as Productive Unit Resourcing (PUR). Under this system, activity funding rate determination is accomplished through the use of a number of algorithms based on contract type and dollar. This

approach, however, ignores the inherent attributes of the goods (and services) that are being purchased.

The use of a classification scheme, such as that proposed in this project, would take into consideration the inherent characteristics of an item (including unit cost), and could help simplify the budget process. Complex buys vs. simple buys could be identified and given appropriate weights.

C. CONCLUSIONS

Based on the research conducted in this project, the following conclusions can be drawn:

1. The Government goods classification scheme is a viable tool for classifying items procured by the Federal Government.

The research documented by this project showed that goods procured by the Federal Government can be classified according to their inherent characteristics. This scheme is superior to other classification schemes which are based solely on commodity types while ignoring other vital attributes, since it conveys more information to the user (buyer).

2. The classification of homogeneous groups of goods do not provide sufficient diversity to draw accurate conclusions when attempting to classify them using classic numerical taxonomic methods, such as cluster analysis.

Cluster analysis, by its very nature, classifies items based on the relationship of the subjects attributes to others in the set being classified. Thus any classification done in this manner is purely relative to the items in the group. When attempting to classify items in a homogeneous group (such as food service equipment) the inferences that can be made are relative only to that subset of the larger universe of all Government goods. Additionally, any classification will be affected by the size of the data set. When classifying goods using numerical taxonomic means, it is important to start with as diverse a group of items as possible, in order to draw inferences that are analogous to the larger set of Government goods.

The Government goods classification scheme is substantially more flexible. It does not rely on classification by comparison with other items being classified, and can be used to classify single items based solely on their characteristics. Additionally, classification can be accomplished without the use of a large statistical computer program, such as SAS.

3. The characteristics used to classify Government goods under the proposed scheme are the "best qualified" to provide the information required about the items.

The six characteristics of Government goods classification scheme proposed by Wenger are the best characteristics for use in this scheme, as validated by the research conducted in this thesis. These characteristics, (complexity, customization, documentation, maintainability, item cost and item attention) provide the most information about the goods being classified. Only six of the original twelve characteristics were retained to simplify the model and to eliminate those characteristics that did not provide any information about the diversity of the goods.

These characteristics are not absolute. Their validity has been shown once by Wenger, and then confirmed by the researcher. Future taxonomists should likewise continue to confirm that these attributes provide the best tools for classifying goods.

4. The data collection scheme needs to be reviewed and streamlined.

In order to create a viable system of classification using the scheme presented in this thesis, the system of data collection needs to be revamped. Asking the data providers (buyers) to provide information about a large

group of goods they may or may not have any experience with can (and did) create difficulties.

Different methods of data collection, such as a system where the buyers provide the data as the items are being bought would enhance the quality of information for classification, since the buyers should be reasonably familiar with the items they are procuring. However, the inflow of data would be relatively slow, and any data collected this way would be dependent on the knowledge of the buyers about the items they are classifying.

5. The scheme for the classification of goods procured by the Federal Government is feasible, and has a number of potential applications.

The scheme can be a useful tool in improving the efficiency of a buying organization by providing a priori information about goods that can be used for workload management, budget justification and in aiding the identification of items that are commercially available. Similarly the scheme can be used in refining legislation and rules by applying the statutes or laws based on the classifications of items, rather than the entire universe of goods.

D. RESEARCH QUESTIONS

The purpose of this section is to answer the research questions outlined in Chapter I.

1. Primary Research Question:

Can the previously developed scheme for the classification of goods procured by the Federal Government be validated by applying it to a group of homogeneous items which are currently being purchased by buying activities within the Department of Defense?

The results of the research conducted in this project validated the scheme for the classification of goods procured by the Federal Government and showed that it can be a viable tool for classifying a variety of items.

2. Subsidiary Research Questions:

a. For the purpose of this procurement research effort, which groups of homogeneous goods should be chosen, and within those homogeneous groups, what a priori attributes should the individual items possess, that will make them useful in confirming the viability of the classificatory scheme?

The items chosen for this research effort should be sufficiently diverse to allow for a range of classifications from simple to complex. The goods selected should also be easily recognizable from their nomenclature, as this is the key that will be used to provide the classification information.

b. Were the characteristics chosen as essential to the proper classification of goods in the previous study, the correct attributes for this type of effort?

In streamlining the model, the researcher determined that the six best characteristics to use in this type of classification effort are: complexity, customization, maintainability, item unit cost, documentation and item attention. This confirms the results of the Wenger study. These attributes should be validated in successive studies.

c. What improvements can be made to the classificatory scheme?

Improvements can be made in the collection of data over the survey method used in this study. A system that enables the buyer (or other provider of data) to provide the data on a real time basis would be preferable to the one used here. The researcher put forth the idea of a "push" system of data collection, where the buyer forwards the classification data at the time of the procurement, ensuring, to the extent possible, that the buyer is familiar with the item being classified.

Another improvement would be to change the scales for the characteristic "item unit cost". The researcher feels it would be preferable to provide a definite dollar value scale to eliminate ambiguity.

d. What are the potential areas of application for this scheme?

There are several areas which would be amenable to application of this scheme. These include workload management, identification of potential commercial item purchases, budget justification and selective application of legislation dealing with goods procured by the Federal Government.

E. AREAS OF FURTHER RESEARCH

Follow-on research is proposed in the following areas:

1. Expand technical descriptions of goods.

The researcher made a decision to provide only a recognizable nomenclature. Further research could be accomplished using the same set of items, but the data collection survey would include a technical description of the good. The technical descriptions could be derived from the Identification Lists (IL's) contained in PARTSMASTER or other technical database.

2. Explore other characteristics that define the good.

There are a significant number of ways to describe a good. This research has concentrated on twelve. Further research could be conducted by developing a different set of

characteristics or features that could be used to classify an item. Such new characteristics could include weight, availability, etc..

The researcher also felt that a classification based on external contracting functions such as the item's usual contract type, usual contract method, contract administration workload, availability in the commercial marketplace, etc., may be useful. This second concept is also appealing in that the data may be derived from existing sources, (i.e. from data collected at time of award on the Individual Contracting Action Report, DD Form 350), rather than relying on the opinions of the buyers. Furthermore, these characteristics may be synthesized into a classification scheme with the attributes described in this project.

3. Develop an "Expert system" for goods classification.

An expert system is a computer based system that "employs human knowledge captured in a computer to solve problems that ordinarily require human expertise". (Turban, 1990, p. 424) The expert system mimics the decision processes of an expert through a knowledge base, consisting of facts and a collection of heuristics (rules of thumb) derived from a human expert, and an inference engine which

draws the conclusions. Additionally, expert systems work on a interactive basis with a human user.

The advantages of an expert system include preservation of expert knowledge, consistency in decision making and ability to distribute the expert knowledge.

For the purpose of follow on research, the knowledge base could be derived from one expert, or synthesized from a group of experts. The creation of the expert system itself should be relatively simple since there are a number of software packages available to build expert systems.

However, given the requirement for some programming, it may be desirable to conduct this as a joint thesis with a student from an Information Technology (IT) curriculum.

4. Research the level of knowledge of buyers.

During the data collection portion of this research effort, there were some anecdotal indications that buyers were not sure of the nature of the items they were asked to classify. In a world where contracting officials are routinely asked to make judgments concerning best value, and fair and reasonable prices, it is imperative that they are knowledgeable about the goods that they are purchasing.

As the Department of Defense works to upgrade the professionalism of the acquisition workforce, it might be timely and worthwhile to ascertain the levels of knowledge

that contracting personnel have about the items they are asked to purchase.

F. SUMMARY

This chapter outlined potential applications for the Government goods classification scheme. Additionally, conclusions, research questions and recommendations for further research were presented.

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APPENDIX A

This appendix defines the characteristics used in the Wenger research project, and validated in this thesis.

CHARACTERISTICS ASSOCIATED WITH GOVERNMENT GOODS

1. Change describes the good's rate of technological transformation. With some goods, their rate of technological change is very low. Their design is fixed and rarely, if ever, changes. Contrast this with those goods that are affected by state-of-the art technology and are characterized by a high rate of technological obsolescence.

SCALE:

1 Very low rate of technological change
2 Low rate of technological change
3 Medium amount of technological change
4 High rate of technological change
5 Very high rate of technological change

2. Complexity describes the good's technical intricacies. The degree of a good's technical complexity may be thought of in terms of the skill and expertise needed to produce the good. Another way to determine complexity is whether the good is a system, sub-assembly, component, piece part, or raw material. For scoring purposes, 1 indicates little or no technological complexity with 5 being very high complexity.

SCALE:

1 Very low technical complexity
2 Low technical complexity
3 Medium technical complexity
4 High technical complexity
5 Very high technical complexity

3. Customization is the degree to which the good is manufactured to the buyer's specifications. Some goods, those that are strictly commercial, have no amount of customization while others are produced exclusively for a buyer, e.g. the Government. Goods that are not customized should be scored 1 with those developed exclusively for the Government scored 5.

SCALE:

1 No amount of customization
2 Low degree of customization
3 Medium amount of customization
4 High amount of customization
5 Made exclusively for the Government

4. Maintainability refers to the amount of maintenance considerations associated with the good. In other words, how frequently, if at all, is maintenance is required on the good. Some goods are virtually maintenance-free while others require a great deal of maintenance throughout their lives.

SCALE:

1 No maintenance required
2 Low maintenance requirements
3 Medium maintenance requirements
4 High maintenance requirements
5 Very high maintenance requirements

5. Homogeneity represents the number of other goods that are similar and are ready substitutes for the good under consideration. Typically, the more common the use of the good, the greater the amount of homogeneity. Highly homogeneous goods should be scored 1 and those with little or none scored 5.

SCALE:

1 Very high homogeneity
2 High homogeneity
3 Medium homogeneity
4 Low homogeneity
5 No homogeneity

6. **Consumption** refers to how rapidly the good is used by the buyer. Some goods are consumed on a continuing basis and require constant replenishment. Others are of a more permanent nature resulting in much less frequent buying. Rapidly consumed goods should be scored 1 and 5 used for goods that are rarely consumed or replaced.

SCALE:

1 Very rapidly consumed good, constant replenishment
2 Rapidly consumed good, constant replenishment
3 Moderate consumption and replenishment
4 Low rate of consumption and replenishment
5 Very low rate of consumption and replenishment

7. **Unit cost** is the good's cost to the buyer. Generally speaking, as a good becomes more unique to the buyer's requirement, the unit value is increasing. To score, use 1 for low unit cost and 5 for very high.

SCALE:

1 Very low unit cost
2 Low unit cost
3 Medium unit cost
4 High unit cost
5 Very high unit cost

8. **Documentation** is another characteristic external to the good yet many times a necessary part of it. Frequently the Government requires substantiating documentation in the form of drawings, technical manuals, and certifications for some types of goods while for others little at all is required. When scoring, a 1 would indicate a good purchased with no accompanying documentation while 5 is for goods accompanied by drawings, technical manuals, etc..

SCALE:

1 No associated documentation
2 Low amount of documentation
3 Medium amount of documentation
4 Great deal of documentation
5 Very high amount of documentation

9. Item attention given by the buyer refers to single-item versus volume or mass buying. When a buyer deals with small dollar-value items like common bolts and rivets, the focus is on a mass quantity of these types of goods. Contrast this with the acquisition of a F-14 aircraft where the buyer's attention is focused on a single item.

SCALE:

1 Complete volume-type attention
2 Mostly volume-type attention
3 Good that could be either volume or single item
4 Good that is usually single-item attention
5 Good that is always single-item attention

10. Sources of supply refers to the number of available sources that provide the same basic type of good. Some types of goods have associated with them a great number of alternate sources while others of a more specialized nature are more restrictive.

SCALE:

1 Virtually unlimited number of suppliers
2 High number of suppliers
3 Adequate number of suppliers
4 One or two sources
5 No sources exist

11. Criticality refers to the buying urgency associated with the good or the necessity of having the good available for the buyer to purchase. This characteristic of a good can be quite dynamic, but some goods, by their nature, may rarely be characterized as critical to the buyer.

SCALE:

1 Never characterized as a critical item
2 Rarely a critical item
3 Sometimes approached as critical
4 Usually characterized as critical
5 Always purchased under critical situations

12. **Stability** refers to the nature of the requirement. With some goods their demand is constant and seldom varies. On the other hand, demand for certain types of goods is much more volatile and uncertain depending on the need for the good and perhaps the technology that is available.

SCALE:

1	Good that is extremely stable
2	High degree of stability
3	Moderate amount of stability
4	Low amount of stability
5	Highly unstable good

APPENDIX B

This appendix provides the survey used to obtain buyer input from the Navy Aviation Supply Office, located in Philadelphia, PA.

1.Change describes the good's rate of technological transformation. With some goods, their rate of technological change is very low. Their design is fixed and rarely, if ever, changes. Contrast this with those goods that are affected by state-of-the art technology and are characterized by a high rate of technological obsolescence.

SCALE:

1 Very low rate of technological change
2 Low rate of technological change
3 Medium amount of technological change
4 High rate of technological change
5 Very high rate of technological change

Item or equipment	Classification Scale (1-5)	Have you ever bought this item? (Y/N)
Sonar Data Control	1 2 3 4 5	Y or N
Fairing, Tailpipe	1 2 3 4 5	Y or N
Leading Edge, Horiz	1 2 3 4 5	Y or N
Flap Assembly	1 2 3 4 5	Y or N
Entry Ladder Tread	1 2 3 4 5	Y or N
Aileron	1 2 3 4 5	Y or N
Lavatory Mirror Frame	1 2 3 4 5	Y or N
Accelerometer, Mechanical	1 2 3 4 5	Y or N
Computer, True Airspeed	1 2 3 4 5	Y or N
Radio Beacon	1 2 3 4 5	Y or N
Wing Tip Red Light Lens	1 2 3 4 5	Y or N
Seat, Toilet, Plastic	1 2 3 4 5	Y or N
Oven Assy, P-3 Galley	1 2 3 4 5	Y or N
Door Assy, RH, Bomb Bay	1 2 3 4 5	Y or N
P-3 Galley Refrigerator	1 2 3 4 5	Y or N
Propeller, Aircraft, Variable Pitch	1 2 3 4 5	Y or N
Radome Boom Assy, MAD	1 2 3 4 5	Y or N
Feather Override Button	1 2 3 4 5	Y or N
Wheel Assembly, NLG	1 2 3 4 5	Y or N

2. **Complexity** describes the good's technical intricacies. The degree of a good's technical complexity may be thought of in terms of the skill and expertise needed to produce the good. Another way to determine complexity is whether the good is a system, sub-assembly, component, piece part, or raw material. For scoring purposes, 1 indicates little or no technological complexity with 5 being very high complexity.

SCALE:

1 Very low technical complexity
2 Low technical complexity
3 Medium technical complexity
4 High technical complexity
5 Very high technical complexity

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

3. **Customization** is the degree to which the good is manufactured to the buyer's specifications. Some goods, those that are strictly commercial, have no amount of customization while others are produced exclusively for a buyer, e.g. the Government. Goods that are not customized should be scored 1 with those developed exclusively for the Government scored 5.

SCALE:

1 No amount of customization
2 Low degree of customization
3 Medium amount of customization
4 High amount of customization
5 Made exclusively for the Government

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
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Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
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P-3 Galley Refrigerator	1 2 3 4 5
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Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

4. Maintainability refers to the amount of maintenance considerations associated with the good. In other words, how frequently, if at all, is maintenance is required on the good. Some goods are virtually maintenance-free while others require a great deal of maintenance throughout their lives.

SCALE:

1 No maintenance required
2 Low maintenance requirements
3 Medium maintenance requirements
4 High maintenance requirements
5 Very high maintenance requirements

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Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
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5. **Homogeneity** represents the number of other goods that are similar and are ready substitutes for the good under consideration. Typically, the more common the use of the good, the greater the amount of homogeneity. Highly homogeneous goods should be scored 1 and those with little or none scored 5.

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Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
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Radome Boom Assy, MAD	1 2 3 4 5
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Wheel Assembly, NLG	1 2 3 4 5

6. **Consumption** refers to how rapidly the good is used by the buyer. Some goods are consumed on a continuing basis and require constant replenishment. Others are of a more permanent nature resulting in much less frequent buying. Rapidly consumed goods should be scored 1 and 5 used for goods that are rarely consumed or replaced.

SCALE:

1 Very rapidly consumed good, constant replenishment
2 Rapidly consumed good, constant replenishment
3 Moderate consumption and replenishment
4 Low rate of consumption and replenishment
5 Very low rate of consumption and replenishment

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

7. **Unit cost** is the good's cost to the buyer. Generally speaking, as a good becomes more unique to the buyer's requirement, the unit value is increasing. To score, use 1 for low unit cost and 5 for very high.

SCALE:

1 Very low unit cost
2 Low unit cost
3 Medium unit cost
4 High unit cost
5 Very high unit cost

Item or equipment	Classification Scale (1-5)
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Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
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Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

8. **Documentation** is another characteristic external to the good yet many times a necessary part of it. Frequently the Government requires substantiating documentation in the form of drawings, technical manuals, and certifications for some types of goods while for others little at all is required. When scoring, a 1 would indicate a good purchased with no accompanying documentation while 5 is for goods accompanied by drawings, technical manuals, etc..

1 No associated documentation
2 Low amount of documentation
3 Medium amount of documentation
4 Great deal of documentation
5 Very high amount of documentation

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

9. **Item attention** given by the buyer refers to single-item versus volume or mass buying. When a buyer deals with small dollar-value items like common bolts and rivets, the focus is on a mass quantity of these types of goods. Contrast this with the acquisition of a F-14 aircraft where the buyer's attention is focused on a single item.

SCALE:

1 Complete volume-type attention
2 Mostly volume-type attention
3 Good that could be either volume or single item
4 Good that is usually single-item attention
5 Good that is always single-item attention

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

10. Sources of supply refers to the number of available sources that provide the same basic type of good. Some types of goods have associated with them a great number of alternate sources while others of a more specialized nature are more restrictive.

SCALE:

1 Virtually unlimited number of suppliers
2 High number of suppliers
3 Adequate number of suppliers
4 One or two sources
5 No sources exist

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

11. Criticality refers to the buying urgency associated with the good or the necessity of having the good available for the buyer to purchase. This characteristic of a good can be quite dynamic, but some goods, by their nature, may rarely be characterized as critical to the buyer.

SCALE:

1 Never characterized as a critical item
2 Rarely a critical item
3 Sometimes approached as critical
4 Usually characterized as critical
5 Always purchased under critical situations

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

12. Stability refers to the nature of the requirement. With some goods their demand is constant and seldom varies. On the other hand, demand for certain types of goods is much more volatile and uncertain depending on the need for the good and perhaps the technology that is available.

SCALE:

1 Good that is extremely stable
2 High degree of stability
3 Moderate amount of stability
4 Low amount of stability
5 Highly unstable good

Item or equipment	Classification Scale (1-5)
Sonar Data Control	1 2 3 4 5
Fairing, Tailpipe	1 2 3 4 5
Leading Edge, Horiz	1 2 3 4 5
Flap Assembly	1 2 3 4 5
Entry Ladder Tread	1 2 3 4 5
Aileron	1 2 3 4 5
Lavatory Mirror Frame	1 2 3 4 5
Accelerometer, Mechanical	1 2 3 4 5
Computer, True Airspeed	1 2 3 4 5
Radio Beacon	1 2 3 4 5
Wing Tip Red Light Lens	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Oven Assy, P-3 Galley	1 2 3 4 5
Door Assy, RH, Bomb Bay	1 2 3 4 5
P-3 Galley Refrigerator	1 2 3 4 5
Propeller, Aircraft, Variable Pitch	1 2 3 4 5
Radome Boom Assy, MAD	1 2 3 4 5
Feather Override Button	1 2 3 4 5
Wheel Assembly, NLG	1 2 3 4 5

APPENDIX C

This appendix provides the survey used to obtain buyer input for goods associated with food service equipment. This information was solicited from buyers at the Defense General Supply Center, located in Richmond, VA.

1. **Change** describes the good's rate of technological transformation. With some goods, their rate of technological change is very low. Their design is fixed and rarely, if ever, changes. Contrast this with those goods that are affected by state-of-the art technology and are characterized by a high rate of technological obsolescence.

1 Very low rate of technological change
2 Low rate of technological change
3 Medium amount of technological change
4 High rate of technological change
5 Very high rate of technological change

Item or equipment	Classification Scale (1-5) (Choose One)	Have you ever bought this item? (Y/N)
Bread Slicing Machine	1 2 3 4 5	Y or N
Fork, Field Mess	1 2 3 4 5	Y or N
Dishwashing Machine	1 2 3 4 5	Y or N
Ice Maker, Flake	1 2 3 4 5	Y or N
Dispenser, Bulk Milk	1 2 3 4 5	Y or N
Oven, Microwave, Elec.	1 2 3 4 5	Y or N
Kettle, Steam Jacketed,	1 2 3 4 5	Y or N
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5	Y or N
Meat Slicer, Electric	1 2 3 4 5	Y or N
Stove, Gasoline Burner	1 2 3 4 5	Y or N
Filter, Coffee Urn	1 2 3 4 5	Y or N
Saw, Band, Meat Cutting	1 2 3 4 5	Y or N
Steam Table	1 2 3 4 5	Y or N
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5	Y or N
Rack, Dishwashing	1 2 3 4 5	Y or N
Waffle Iron, Electric	1 2 3 4 5	Y or N
Steam Table	1 2 3 4 5	Y or N
Vegetable Peeler, Elec.	1 2 3 4 5	Y or N
Coffee Maker/Percolator	1 2 3 4 5	Y or N

2. **Complexity** describes the good's technical intricacies. The degree of a good's technical complexity may be thought of in terms of the skill and expertise needed to produce the good. Another way to determine complexity is whether the good is a system, sub-assembly, component, piece part, or raw material. For scoring purposes, 1 indicates little or no technological complexity with 5 being very high complexity.

1 Very low technical complexity
2 Low technical complexity
3 Medium technical complexity
4 High technical complexity
5 Very high technical complexity

Item or equipment	Classification Scale (1-5)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

3. **Customization** is the degree to which the good is manufactured to the buyer's specifications. Some goods, those that are strictly commercial, have no amount of customization while others are produced exclusively for a buyer, e.g. the Government. Goods that are not customized should be scored 1 with those developed exclusively for the Government scored 5.

1 No amount of customization
2 Low degree of customization
3 Medium amount of customization
4 High amount of customization
5 Made exclusively for the Government

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

4. **Maintainability** refers to the amount of maintenance considerations associated with the good. In other words, how frequently, if at all, is maintenance is required on the good. Some goods are virtually maintenance-free while others require a great deal of maintenance throughout their lives.

SCALE:

1 No maintenance required
2 Low maintenance requirements
3 Medium maintenance requirements
4 High maintenance requirements
5 Very high maintenance requirements

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

5. **Homogeneity** represents the number of other goods that are similar and are ready substitutes for the good under consideration. Typically, the more common the use of the good, the greater the amount of homogeneity. Highly homogeneous goods should be scored 1 and those with little or none scored 5.

SCALE:

1 Very high homogeneity
2 High homogeneity
3 Medium homogeneity
4 Low homogeneity
5 No homogeneity

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

6. **Consumption** refers to how rapidly the good is used by the buyer. Some goods are consumed on a continuing basis and require constant replenishment. Others are of a more permanent nature resulting in much less frequent buying. Rapidly consumed goods should be scored 1 and 5 used for goods that are rarely consumed or replaced.

1 Very rapidly consumed good, constant replenishment
2 Rapidly consumed good, constant replenishment
3 Moderate consumption and replenishment
4 Low rate of consumption and replenishment
5 Very low rate of consumption and replenishment

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

7. **Unit cost** is the good's cost to the buyer. Generally speaking, as a good becomes more unique to the buyer's requirement, the unit value is increasing. To score, use 1 for low unit cost and 5 for very high.

SCALE:

1 Very low unit cost
2 Low unit cost
3 Medium unit cost
4 High unit cost
5 Very high unit cost

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

8. **Documentation** is another characteristic external to the good yet many times a necessary part of it. Frequently the Government requires substantiating documentation in the form of drawings, technical manuals, and certifications for some types of goods while for others little at all is required. When scoring, a 1 would indicate a good purchased with no accompanying documentation while 5 is for goods accompanied by drawings, technical manuals, etc..

1 No associated documentation
2 Low amount of documentation
3 Medium amount of documentation
4 Great deal of documentation
5 Very high amount of documentation

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fab	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

9. **Item attention** given by the buyer refers to single-item versus volume or mass buying. When a buyer deals with small dollar-value items like common bolts and rivets, the focus is on a mass quantity of these types of goods. Contrast this with the acquisition of a F-14 aircraft where the buyer's attention is focused on a single item.

SCALE:

1 Complete volume-type attention
2 Mostly volume-type attention
3 Good that could be either volume or single item
4 Good that is usually single-item attention
5 Good that is always single-item attention

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

10. Sources of supply refers to the number of available sources that provide the same basic type of good. Some types of goods have associated with them a great number of alternate sources while others of a more specialized nature are more restrictive.

SCALE:

1 Virtually unlimited number of suppliers
2 High number of suppliers
3 Adequate number of suppliers
4 One or two sources
5 No sources exist

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

11. Criticality refers to the buying urgency associated with the good or the necessity of having the good available for the buyer to purchase. This characteristic of a good can be quite dynamic, but some goods, by their nature, may rarely be characterized as critical to the buyer.

SCALE:

1 Never characterized as a critical item
2 Rarely a critical item
3 Sometimes approached as critical
4 Usually characterized as critical
5 Always purchased under critical situations

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

12. Stability refers to the nature of the requirement. With some goods their demand is constant and seldom varies. On the other hand, demand for certain types of goods is much more volatile and uncertain depending on the need for the good and perhaps the technology that is available.

SCALE:

1 Good that is extremely stable
2 High degree of stability
3 Moderate amount of stability
4 Low amount of stability
5 Highly unstable good

Item or equipment	Classification Scale (1-5) (Choose One)
Bread Slicing Machine	1 2 3 4 5
Fork, Field Mess	1 2 3 4 5
Dishwashing Machine	1 2 3 4 5
Ice Maker, Flake	1 2 3 4 5
Dispenser, Bulk Milk	1 2 3 4 5
Oven, Microwave, Elec.	1 2 3 4 5
Kettle, Steam Jacketed	1 2 3 4 5
Ice Cream & Shake Maker Soft Serve/Refrigerated	1 2 3 4 5
Meat Slicer, Electric	1 2 3 4 5
Stove, Gasoline Burner	1 2 3 4 5
Filter, Coffee Urn	1 2 3 4 5
Saw, Band, Meat Cutting	1 2 3 4 5
Steam Table	1 2 3 4 5
Refrigerator, Pre-fabricated (Walk-in)	1 2 3 4 5
Rack, Dishwashing	1 2 3 4 5
Waffle Iron, Electric	1 2 3 4 5
Steam Table	1 2 3 4 5
Vegetable Peeler, Elec.	1 2 3 4 5
Coffee Maker/Percolator	1 2 3 4 5

APPENDIX D

This appendix provides the survey used to obtain buyer input for goods associated with ship and marine equipment. This information was solicited from buyers at the Defense General Supply Center (DGSC), located in Richmond, VA.

1. **Change** describes the good's rate of technological transformation. With some goods, their rate of technological change is very low. Their design is fixed and rarely, if ever, changes. Contrast this with those goods that are affected by state-of-the art technology and are characterized by a high rate of technological obsolescence.

SCALE:

1 Very low rate of technological change
2 Low rate of technological change
3 Medium amount of technological change
4 High rate of technological change
5 Very high rate of technological change

Item or equipment	Classification Scale (1-5) (Choose One)	Have you ever bought this item? (Y/N)
Chair, Straight	1 2 3 4 5	Y or N
Buoy Flag	1 2 3 4 5	Y or N
Container, Trash	1 2 3 4 5	Y or N
Ratguard, Ship	1 2 3 4 5	Y or N
Tiedown Assembly	1 2 3 4 5	Y or N
Anchor, Fluked, 750 Lbs	1 2 3 4 5	Y or N
Landing Ship Bow Ramp	1 2 3 4 5	Y or N
Console, Ship Control	1 2 3 4 5	Y or N
Propeller	1 2 3 4 5	Y or N
Rudder	1 2 3 4 5	Y or N
Seat, Toilet, Plastic	1 2 3 4 5	Y or N
Door, Watertight	1 2 3 4 5	Y or N
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5	Y or N
Buoy, Navigational Marker, Nun	1 2 3 4 5	Y or N
Stanchion Assembly	1 2 3 4 5	Y or N
Hatch Restraint	1 2 3 4 5	Y or N
Cathodic Rod	1 2 3 4 5	Y or N
Desk, Flat Top	1 2 3 4 5	Y or N

2. **Complexity** describes the good's technical intricacies. The degree of a good's technical complexity may be thought of in terms of the skill and expertise needed to produce the good. Another way to determine complexity is whether the good is a system, sub-assembly, component, piece part, or raw material. For scoring purposes, 1 indicates little or no technological complexity with 5 being very high complexity.

SCALE:

1 Very low technical complexity
2 Low technical complexity
3 Medium technical complexity
4 High technical complexity
5 Very high technical complexity

Item or equipment	Classification Scale (1-5) (Choose One)
Chair, Straight	1 2 3 4 5
Buoy, Flag	1 2 3 4 5
Container, Trash	1 2 3 4 5
Ratguard, Ship	1 2 3 4 5
Tiedown Assembly	1 2 3 4 5
Anchor, Fluked, 750 Lbs	1 2 3 4 5
Landing Ship Bow Ramp	1 2 3 4 5
Console, Ship Control	1 2 3 4 5
Propeller	1 2 3 4 5
Rudder	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Door, Watertight	1 2 3 4 5
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5
Buoy, Navigational Marker, Nun	1 2 3 4 5
Stanchion Assembly	1 2 3 4 5
Hatch Restraint	1 2 3 4 5
Cathodic Rod	1 2 3 4 5
Desk Flat Top	1 2 3 4 5

3. **Customization** is the degree to which the good is manufactured to the buyer's specifications. Some goods, those that are strictly commercial, have no amount of customization while others are produced exclusively for a buyer, e.g. the Government. Goods that are not customized should be scored 1 with those developed exclusively for the Government scored 5.

SCALE:

1 No amount of customization
2 Low degree of customization
3 Medium amount of customization
4 High amount of customization
5 Made exclusively for the Government

Item or equipment	Classification Scale (1-5) (Choose One)
Chair, Straight	1 2 3 4 5
Buoy, Flag	1 2 3 4 5
Container, Trash	1 2 3 4 5
Ratguard, Ship	1 2 3 4 5
Tiedown Assembly	1 2 3 4 5
Anchor, Fluked, 750 Lbs	1 2 3 4 5
Landing Ship Bow Ramp	1 2 3 4 5
Console, Ship Control	1 2 3 4 5
Propeller	1 2 3 4 5
Rudder	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Door, Watertight	1 2 3 4 5
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5
Buoy, Navigational Marker, Nun	1 2 3 4 5
Stanchion Assembly	1 2 3 4 5
Hatch Restraint	1 2 3 4 5
Cathodic Rod	1 2 3 4 5
Desk Flat Top	1 2 3 4 5

4. Maintainability refers to the amount of maintenance considerations associated with the good. In other words, how frequently, if at all, is maintenance is required on the good. Some goods are virtually maintenance-free while others require a great deal of maintenance throughout their lives.

SCALE:

1 No maintenance required
2 Low maintenance requirements
3 Medium maintenance requirements
4 High maintenance requirements
5 Very high maintenance requirements

Item or equipment	Classification Scale (1-5) (Choose One)
Chair, Straight	1 2 3 4 5
Buoy, Flag	1 2 3 4 5
Container, Trash	1 2 3 4 5
Ratguard, Ship	1 2 3 4 5
Tiedown Assembly	1 2 3 4 5
Anchor, Fluked, 750 Lbs	1 2 3 4 5
Landing Ship Bow Ramp	1 2 3 4 5
Console, Ship Control	1 2 3 4 5
Propeller	1 2 3 4 5
Rudder	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Door, Watertight	1 2 3 4 5
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5
Buoy, Navigational Marker, Nun	1 2 3 4 5
Stanchion Assembly	1 2 3 4 5
Hatch Restraint	1 2 3 4 5
Cathodic Rod	1 2 3 4 5
Desk Flat Top	1 2 3 4 5

5. **Homogeneity** represents the number of other goods that are similar and are ready substitutes for the good under consideration. Typically, the more common the use of the good, the greater the amount of homogeneity. Highly homogeneous goods should be scored 1 and those with little or none scored 5.

SCALE:

1 Very high homogeneity
2 High homogeneity
3 Medium homogeneity
4 Low homogeneity
5 No homogeneity

Item or equipment	Classification Scale (1-5) (Choose One)
Chair, Straight	1 2 3 4 5
Buoy, Flag	1 2 3 4 5
Container, Trash	1 2 3 4 5
Ratguard, Ship	1 2 3 4 5
Tiedown Assembly	1 2 3 4 5
Anchor, Fluked, 750 Lbs	1 2 3 4 5
Landing Ship Bow Ramp	1 2 3 4 5
Console, Ship Control	1 2 3 4 5
Propeller	1 2 3 4 5
Rudder	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Door, Watertight	1 2 3 4 5
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5
Buoy, Navigational Marker, Nun	1 2 3 4 5
Stanchion Assembly	1 2 3 4 5
Hatch Restraint	1 2 3 4 5
Cathodic Rod	1 2 3 4 5
Desk Flat Top	1 2 3 4 5

6. **Consumption** refers to how rapidly the good is used by the buyer. Some goods are consumed on a continuing basis and require constant replenishment. Others are of a more permanent nature resulting in much less frequent buying. Rapidly consumed goods should be scored 1 and 5 used for goods that are rarely consumed or replaced.

SCALE:

1 Very rapidly consumed good, constant replenishment

2 Rapidly consumed good, constant replenishment

3 Moderate consumption and replenishment

4 Low rate of consumption and replenishment

5 Very low rate of consumption and replenishment

Item or equipment	Classification Scale (1-5) (Choose One)
Chair, Straight	1 2 3 4 5
Buoy, Flag	1 2 3 4 5
Container, Trash	1 2 3 4 5
Ratguard, Ship	1 2 3 4 5
Tiedown Assembly	1 2 3 4 5
Anchor, Fluked, 750 Lbs	1 2 3 4 5
Landing Ship Bow Ramp	1 2 3 4 5
Console, Ship Control	1 2 3 4 5
Propeller	1 2 3 4 5
Rudder	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Door, Watertight	1 2 3 4 5
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5
Buoy, Navigational Marker, Nun	1 2 3 4 5
Stanchion Assembly	1 2 3 4 5
Hatch Restraint	1 2 3 4 5
Cathodic Rod	1 2 3 4 5
Desk Flat Top	1 2 3 4 5

7. **Unit cost** is the good's cost to the buyer. Generally speaking, as a good becomes more unique to the buyer's requirement, the unit value is increasing. To score, use 1 for low unit cost and 5 for very high.

SCALE:

1 Very low unit cost
2 Low unit cost
3 Medium unit cost
4 High unit cost
5 Very high unit cost

Item or equipment	**Classification Scale (1-5) (Choose One)**
Chair, Straight	**1 2 3 4 5**
Buoy, Flag	**1 2 3 4 5**
Container, Trash	**1 2 3 4 5**
Ratguard, Ship	**1 2 3 4 5**
Tiedown Assembly	**1 2 3 4 5**
Anchor, Fluked, 750 Lbs	**1 2 3 4 5**
Landing Ship Bow Ramp	**1 2 3 4 5**
Console, Ship Control	**1 2 3 4 5**
Propeller	**1 2 3 4 5**
Rudder	**1 2 3 4 5**
Seat, Toilet, Plastic	**1 2 3 4 5**
Door, Watertight	**1 2 3 4 5**
Anchor, Mushroom (4000 Lbs)	**1 2 3 4 5**
Buoy, Navigational Marker, Nun	**1 2 3 4 5**
Stanchion Assembly	**1 2 3 4 5**
Hatch Restraint	**1 2 3 4 5**
Cathodic Rod	**1 2 3 4 5**
Desk Flat Top	**1 2 3 4 5**

8. Documentation is another characteristic external to the good yet many times a necessary part of it. Frequently the Government requires substantiating documentation in the form of drawings, technical manuals, and certifications for some types of goods while for others little at all is required. When scoring, a 1 would indicate a good purchased with no accompanying documentation while 5 is for goods accompanied by drawings, technical manuals, etc..

SCALE:

1 No associated documentation
2 Low amount of documentation
3 Medium amount of documentation
4 Great deal of documentation
5 Very high amount of documentation

Item or equipment	**Classification Scale (1-5) (Choose One)**
Chair, Straight	**1 2 3 4 5**
Buoy, Flag	**1 2 3 4 5**
Container, Trash	**1 2 3 4 5**
Ratguard, Ship	**1 2 3 4 5**
Tiedown Assembly	**1 2 3 4 5**
Anchor, Fluked, 750 Lbs	**1 2 3 4 5**
Landing Ship Bow Ramp	**1 2 3 4 5**
Console, Ship Control	**1 2 3 4 5**
Propeller	**1 2 3 4 5**
Rudder	**1 2 3 4 5**
Seat, Toilet, Plastic	**1 2 3 4 5**
Door, Watertight	**1 2 3 4 5**
Anchor, Mushroom (4000 Lbs)	**1 2 3 4 5**
Buoy, Navigational Marker, Nun	**1 2 3 4 5**
Stanchion Assembly	**1 2 3 4 5**
Hatch Restraint	**1 2 3 4 5**
Cathodic Rod	**1 2 3 4 5**
Desk Flat Top	**1 2 3 4 5**

9. **Item attention** given by the buyer refers to single-item versus volume or mass buying. When a buyer deals with small dollar-value items like common bolts and rivets, the focus is on a mass quantity of these types of goods. Contrast this with the acquisition of a F-14 aircraft where the buyer's attention is focused on a single item.

SCALE:

1 Complete volume-type attention
2 Mostly volume-type attention
3 Good that could be either volume or single item
4 Good that is usually single-item attention
5 Good that is always single-item attention

Item or equipment	**Classification Scale (1-5) (Choose One)**
Chair, Straight	**1 2 3 4 5**
Buoy, Flag	**1 2 3 4 5**
Container, Trash	**1 2 3 4 5**
Ratguard, Ship	**1 2 3 4 5**
Tiedown Assembly	**1 2 3 4 5**
Anchor, Fluked, 750 Lbs	**1 2 3 4 5**
Landing Ship Bow Ramp	**1 2 3 4 5**
Console, Ship Control	**1 2 3 4 5**
Propeller	**1 2 3 4 5**
Rudder	**1 2 3 4 5**
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Buoy, Navigational Marker, Nun	**1 2 3 4 5**
Stanchion Assembly	**1 2 3 4 5**
Hatch Restraint	**1 2 3 4 5**
Cathodic Rod	**1 2 3 4 5**
Desk Flat Top	**1 2 3 4 5**

10. Sources of supply refers to the number of available sources that provide the same basic type of good. Some types of goods have associated with them a great number of alternate sources while others of a more specialized nature are more restrictive.

SCALE:

1 Virtually unlimited number of suppliers
2 High number of suppliers
3 Adequate number of suppliers
4 One or two sources
5 No sources exist

Item or equipment	**Classification Scale (1-5) (Choose One)**
Chair, Straight	**1 2 3 4 5**
Buoy, Flag	**1 2 3 4 5**
Container, Trash	**1 2 3 4 5**
Ratguard, Ship	**1 2 3 4 5**
Tiedown Assembly	**1 2 3 4 5**
Anchor, Fluked, 750 Lbs	**1 2 3 4 5**
Landing Ship Bow Ramp	**1 2 3 4 5**
Console, Ship Control	**1 2 3 4 5**
Propeller	**1 2 3 4 5**
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Seat, Toilet, Plastic	**1 2 3 4 5**
Door, Watertight	**1 2 3 4 5**
Anchor, Mushroom (4000 Lbs)	**1 2 3 4 5**
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Stanchion Assembly	**1 2 3 4 5**
Hatch Restraint	**1 2 3 4 5**
Cathodic Rod	**1 2 3 4 5**
Desk Flat Top	**1 2 3 4 5**

11. Criticality refers to the buying urgency associated with the good or the necessity of having the good available for the buyer to purchase. This characteristic of a good can be quite dynamic, but some goods, by their nature, may rarely be characterized as critical to the buyer.

SCALE:

1 Never characterized as a critical item
2 Rarely a critical item
3 Sometimes approached as critical
4 Usually characterized as critical
5 Always purchased under critical situations

Item or equipment	**Classification Scale (1-5) (Choose One)**
Chair, Straight	**1 2 3 4 5**
Buoy, Flag	**1 2 3 4 5**
Container, Trash	**1 2 3 4 5**
Ratguard, Ship	**1 2 3 4 5**
Tiedown Assembly	**1 2 3 4 5**
Anchor, Fluked, 750 Lbs	**1 2 3 4 5**
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Hatch Restraint	**1 2 3 4 5**
Cathodic Rod	**1 2 3 4 5**
Desk Flat Top	**1 2 3 4 5**

12. **Stability** refers to the nature of the requirement. With some goods their demand is constant and seldom varies. On the other hand, demand for certain types of goods is much more volatile and uncertain depending on the need for the good and perhaps the technology that is available.

SCALE:

1 Good that is extremely stable
2 High degree of stability
3 Moderate amount of stability
4 Low amount of stability
5 Highly unstable good

Item or equipment	Classification Scale (1-5) (Choose One)
Chair, Straight	1 2 3 4 5
Buoy, Flag	1 2 3 4 5
Container, Trash	1 2 3 4 5
Ratguard, Ship	1 2 3 4 5
Tiedown Assembly	1 2 3 4 5
Anchor, Fluked, 750 Lbs	1 2 3 4 5
Landing Ship Bow Ramp	1 2 3 4 5
Console, Ship Control	1 2 3 4 5
Propeller	1 2 3 4 5
Rudder	1 2 3 4 5
Seat, Toilet, Plastic	1 2 3 4 5
Door, Watertight	1 2 3 4 5
Anchor, Mushroom (4000 Lbs)	1 2 3 4 5
Buoy, Navigational Marker, Nun	1 2 3 4 5
Stanchion Assembly	1 2 3 4 5
Hatch Restraint	1 2 3 4 5
Cathodic Rod	1 2 3 4 5
Desk Flat Top	1 2 3 4 5

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